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# INSTRUMENTS

## INDUSTRIAL — SCIENTIFIC

Devoted to the Instrument Problems of all Industries

Vol. 1. No. 5 Pittsburgh, Pa. May, 1928

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Electrical Standards.
PROF. W. R. WORK, PITTSBURGH, PA.

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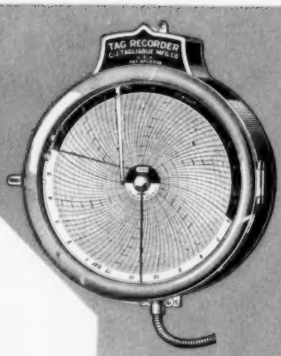

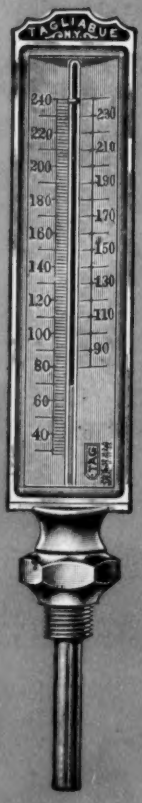

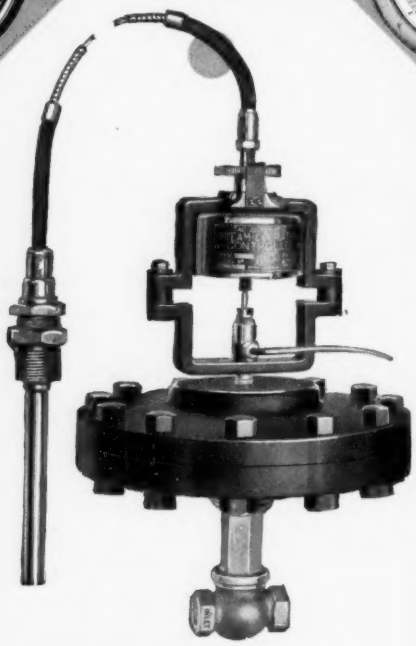

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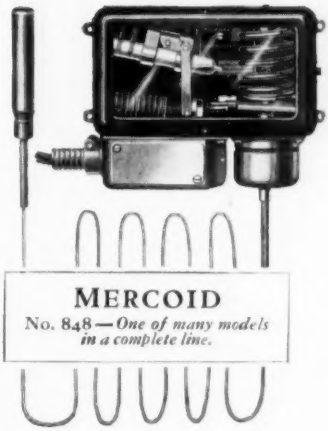

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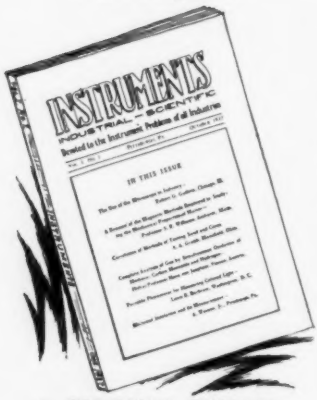


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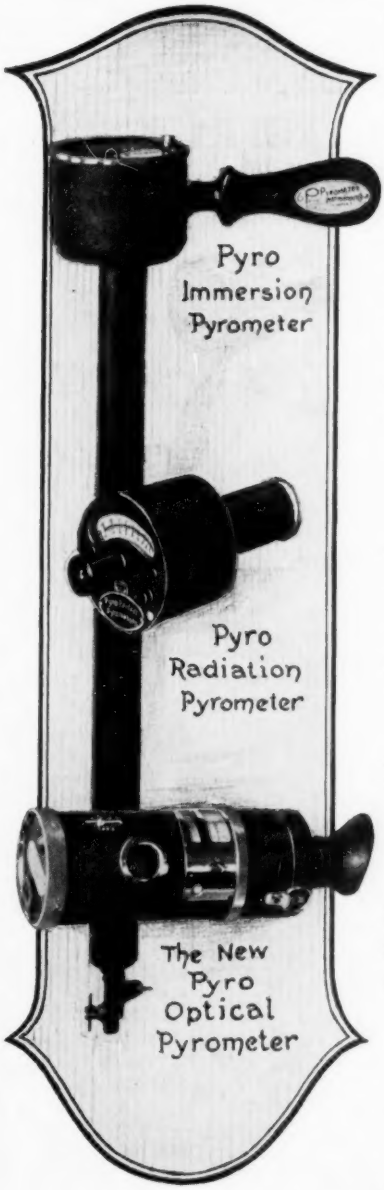


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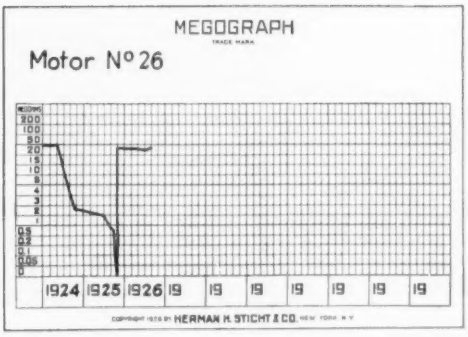


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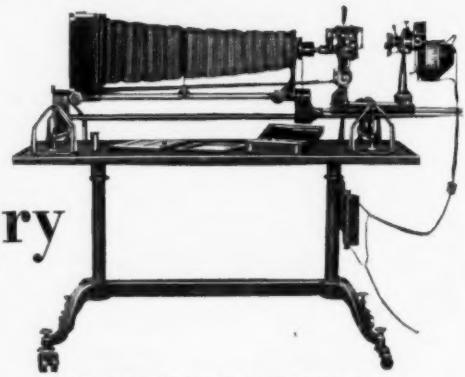

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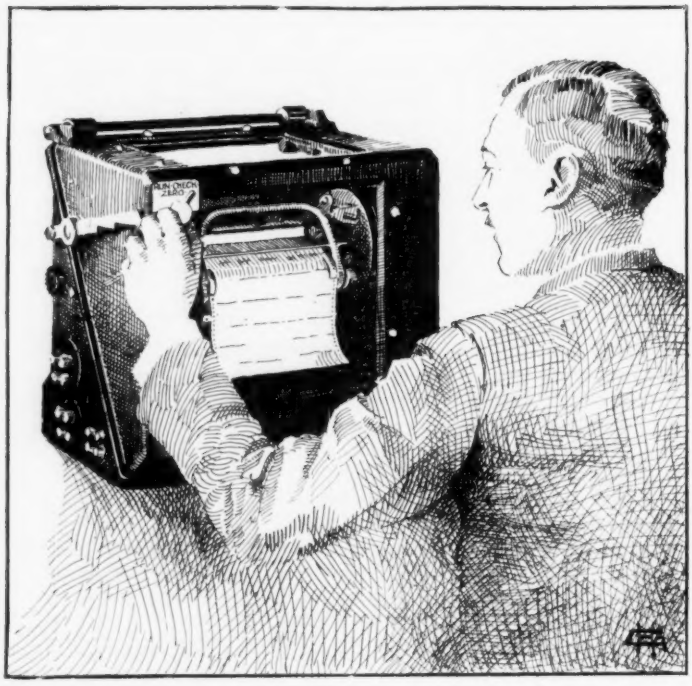

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## To Our Readers

UNDOUBTEDLY the catalogues of a decade or so ago lived up to the strict dictionary definition "a list of things." Today, however, a catalogue is the result of no small effort and expense on the part of the manufacturer, who sets forth the merits of his product in such a manner that the public is made to recognize all its good points. Details of manufacture and operation of the instrument are given in considerable detail. It is a learned mind, indeed, that cannot derive some information from this type of literature. As a matter of fact, few books can be purchased where the information contained therein is more up-to-date than that found in the average catalogue.

The editor has established that upward of 100 pieces of trade literature are published each month on the subject of engineering instruments. It is very difficult for individuals to receive all those in which they are interested. If their name is on the mailing list of an instrument company, they will receive the literature from that company. Sometimes their name is classified by the company to receive certain literature; this may cause them to miss some, which they would like to receive. If their name is not on any company's list, it is obvious that they will receive no literature.

One item of sales expense is the cost of catalogues and bulletins. As each piece sent out costs a very definite amount, the value received would be increased if the literature is received by men, who are interested. This is especially true as the interested men will file the catalogue for future reference and not throw it away. It therefore behooves the instrument companies to make every effort to see that their literature is received by interested parties.

The Catalogue Library of INSTRUMENTS each month lists the catalogues and bulletins received during the previous month. Some companies have intentionally or inadvertently failed to send us their new literature and we urge these to send us these for listing in this section and for our files.

For the convenience of INSTRUMENTS' Readers the Catalogue Library is arranged so that the man may check the catalogues which he would like to receive, fill in his name on the coupon, tear out the page and mail it to us. We will forward these requests with others received at the same time to the companies. Only such catalogues or bulletins should

be requested as will be of direct interest to the individual making the request. When the catalogue or bulletin is received it should be carefully filed or afforded the protective accommodation of a shelf. It will then be available for ready reference at all times and avoid a request for duplicate copies.

To date over 600 requests for literature have been received, and the instrument companies are again urged to cooperate with us by sending us all new literature published by them.

———— :: ————

## Course for Electric Metermen at the Carnegie Institute of Technology

THE fourth annual short course for electric metermen will be held by the Electrical Engineering Department of the Carnegie Institute of Technology from May 21 to 26 inclusive.

The course is given under the direction of the Faculty of the Electrical Engineering Department and the following specialists: O. Buys, Meter Superintendent, Duquesne Light Company; T. C. Pitzer, Meter Engineer, West Penn Power Company; M. F. Smalley, Meter Superintendent, Ohio Power Company; R. A. Markel, Meter Engineer, Associated Gas and Electric System; R. F. Bailey, Penn Central Light and Power Company.

The course is divided into several parts: 1) A series of lectures by educators and specialists from operating and manufacturing companies; 2) Lectures, demonstrations and discussions on different subjects chosen by the student; and 3) A Manufacturer's exhibit of meters and testing devices, as well as new developments.

In this issue are contained two of the lectures, which will be given and future issues of INSTRUMENTS will contain other lectures. If, therefore, you or members of your organization desire to receive copies of these lectures fill out the subscription blank contained in this issue.

———— :: ————

## The New Subscription Form

IN order to facilitate the work of classifying our subscribers according to the kinds of instruments in which they are interested, we have revised the subscription form. The new form will be found in back of the book in front of the file cards.

Another new feature of this form is the back. All old and new Subscribers are urged to cooperate with us by filling out the back of the form and sending it to us.

A special subscription list, to contain 10,000 names, is now being started. Those individuals who return the subscription blank, which is bound in the back of the book, completely filled out on both sides, marked *special* across the face and enclose the same with a letter to us requesting that their name be placed on this list, will receive all special issues of INSTRUMENTS.

## The New Seismic Station at Fordham University

IN this issue will be found a description of the new Seismic Station at Fordham University. The Editor had the pleasure of meeting Prof. Tynan a short time ago and was very much interested by what he had to say on the importance of the work carried out by the various seismic stations.

Most people are curious to know whether the investigations that are made have any practical value. On April 23rd we read the reports of the Corinthian earthquake, which practically wiped out this city killing some twenty or thirty people. It was not a new experience for this city as it was completely destroyed in 1858, also by seismic disturbance. The area within which an earthquake is destructive on a large scale is usually rather small. Consequently if we are able to locate the danger zones, we thereby free the rest of the locality from apprehension which is a great economic asset. Also, within the zones where there is found to be danger it is possible to take precautions.

Seismic methods can also be used to supplement geological knowledge. The great improvement in seismographs has made it possible for geophysicists to adopt them to the study of the hidden geology of the oil and ore fields and to the discovery of new deposits. This application has grown in the last three or four years to such an extent that most oil companies have seismic departments and a crew of the men using these instruments to map the layers of rocks under ground in the locations, where they suspect might be a hidden oil deposit.

The seismograph can be used to study shock waves transmitted through the earth to buildings and other structures by traffic, railroads, drop hammers, rolling mills or other heavy moving machinery, blasting, etc. Precautions in the way of provisions in the building code can be made to prevent damage.

In mining operations very often earth adjustments take place which may cause cave-ins. Seismic instruments may be used to watch for such earth movements with the object of preventing loss of life.

In the reconstruction of this station about $12,000 were expended over and above the generous gifts, which were received for this purpose by the University. The installation of short period seismographs for the registration of nearby quakes is still necessary to make the equipment complete, and able to render valuable service to New York and the Eastern portion of the United States. Fellowships should also be established to carry out research work leading to improvements in the instruments; to study and correlate records obtained, determining what they reveal concerning the nature of the earth's interior; the nature, velocity and transmission of elastic waves through the earth, etc.

New York, the largest city in the world, should not overlook this opportunity to have an up-to-date Seismic station.

## The Return of January Issues of Instruments

REQUESTS for copies of the January issue of INSTRUMENTS are being received daily. A number of these requests are from large circulating and reference libraries who are anxious to have complete bound volumes of INSTRUMENTS on their shelves.

We therefore are making a special appeal to those of our readers who do not intend saving this issue for future reference, to return their copies of the January issue to us. We will send 25 cents in stamps to all those returning this issue, so urge you to place your name and address on the package.

———— :: ————

## Coming to Grips with the Subject

THE editor received a letter from Mr. John L. Hodgson, one of our English collaborators, from which the following quotation is taken:

"I think that your paper has features which commend it above any similar publication, but I believe also that I have some criticism to make (which I suppose I am entitled to make, being one of your collaborators). As far as I remember the main criticism is that the preliminary padding in each article is too long, and that the authors of the papers should be encouraged to get to grips with their subjects more quickly."

The editor would like to repeat here the advice contained in a memorandum of Dr. H. Foster Bain, as director of the Bureau of Mines to his staff:

> "Some tendency has begun to appear for the authors to attempt to crowd too much into a report. It should be remembered that the editors of the various journals work under limitations as to space and time and cannot use long articles. Neither do they always have time to digest and summarize something which the author has not felt sufficiently interested in to boil down to simple essential statements. In the end a much larger audience will be reached more promptly if time be put on thinking out the few right words than on writing many that are about right. Study condensation. Analyze your material. Select your best illustrations, rather than list all you know. A report that runs to more than ten double-spaced typewritten pages will be put aside by many editors to condense later—and next week something else takes his time."

The why and wherefore of the changes made by the editor will be appreciated by those familiar with the details of publishing. The editor must conform to the established typographical style. Alterations may be found advisable to make the article understandable to all the readers, not only those who, like the author, are specialists on the subject. Brevity in presentation and clarity in expression is aimed at by the editor. Being human, he fails occasionally.

We consider all readers as prospective contributors and appreciate a sympathetic understanding of our problems, as well as cooperation.

———— :: ————

## Why Not Build Aircraft Instruments?

IT was called to the editor's attention that he drew an incorrect conclusion in an editorial under the above caption in the April issue as to the dependability of instruments, based upon the note dropped by

Chamberlain. We quote from a letter received from Mr. Colvin of the Pioneer Instrument Company:

> "Since unfavorable reference is made to two of our instruments, we wish to place the facts before you:
>
> "The Climb Indicator used on this ship was of the two unit type, in which connection is made between the indicator and the tank by means of a length of brass tube. This tube line was not secured and was broken by the vibration. With the breaking of the tube, the instrument of course ceased to function.
>
> "The Turn Indicator on this ship was driven by a type V 74 B venturi tube which is designed for operation of the instrument at speeds in excess of 75 miles per hour. At the time the note was dropped, the airplane was flying below 45 miles per hour. I enclose a Turn Indicator circular which contains information regarding the proper venturi tubes to be used at various speeds.
>
> "The quotation in your editorial was used as evidence of the need for dependable instruments. As you will see from the above facts, one failure was due to improper installation and the other to selection of the wrong equipment."

Proper installation and care of instruments is just as important as accuracy and dependability. It is very often the case that first class instruments are purchased and the installation is left to men who are poor workmen or who do not follow the instructions issued with the instrument. INSTRUMENTS has already pointed out the importance of following the instructions issued with instruments.

———— :: ————

## Galileo Galilei

DUE to an oversight the authority for the abridged history of Galilei published in the April issue, was omitted. It is given here:

Ball—Great Astronomers.
Bolton—Famous Men of Science.
Brewster—Martyrs of Science.
Fahis—Galileo; his life and work.

A letter, which calls attention to inaccurate history in this sketch, received from Mr. J. B. Keller, will be found in the Readers' Comment Section.

———— :: ————

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| Plant Engineer | Physicist |
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| Production Engineer | Test Engineer |
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## Contents of Subsequent Issues

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Determination of Parallelism of Measuring Surfaces of Measuring Tools.
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The Importance of Measurements in the Power Plant.
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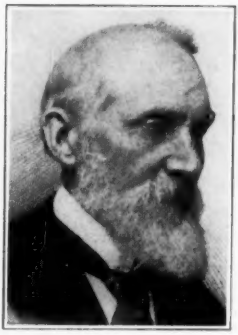
The Measurement of Pressure.
Speed Recording Instruments
Engine Indicators.
New Inventions Needed.
Instruments applied to the Open Hearth for Efficiency.
Thermoradiometers.
Mechanical Vibrations and Their Measurement.
Instruments to improve Diesel Engine Efficiency.
Comparison of Instruments for Measuring Hardness.



# Instrument Pioneers

## William Thomson (Lord Kelvin)

### (1824-1907)

WILLIAM THOMSON, born in Belfast in 1824, received his early training in the Royal Academic Institute of that city. His father, James Thomson, a mathematician of note, having been appointed to the chair of mathematics in the University of Glasgow, proceeded early in the summer of 1832 to Scotland, accompanied by his two sons, William and James.

After a period of preparatory study, the two brothers, who were ten and eleven years of age, respectively, matriculated at the University. At fourteen, William had finished his work at the university, and captured the first prizes in mathematics, astronomy and natural philosophy.

In the summer of 1840, he accompanied his father and brother on a tour through Germany, partly to see the country and partly also to acquire a practical knowledge of the language. Shortly after returning home, Thomson was sent to the University of Cambridge, where he entered St. Peter's College. Thomson knew how to combine recreation with his studies, for he was fond of music, and so proficient in the art that he was elected President of the Musical Society. He also took an interest in water sports. Expert in the navigation of his yacht, he liked to be out on the deep, on these occasions he usually studied, pencil in hands, problems connected with navigation and hydrodynamics.

Thomson was never without his note-book. Even on his journeys to London, when he usually took the night train to save time, his mind was active, and the green-book was a frequent requisition to receive thoughts that occurred relative to problems that engaged his attention.

On leaving Cambridge in 1845, Thomson proceeded to London, and was warmly received by Faraday, then of world wide reputation. He next went to Paris, where in the laboratory of Regnault, he devoted himself to original research. The year 1846 marks an epoch in Thomson's life; for in that year, he was chosen to succeed Nichol, his friend and master, in the chair of natural philosophy at the University of Glasgow.

Impressed with the value of the experimental work which he did under Regnault in Paris, Thomson gave himself no rest until he secured a

place in which the demonstrations of the lecture-room could be supplemented by qualitative and quantitative work in the laboratory. This was the first "physical laboratory" open to students in Great Britain. Two apartments were allotted to him for experimental purposes: An abandoned wine cellar and a disused examination-room, to which, as time went on, were added a corridor, some spare attics, and even the university tower itself, so great was the power of annexation possessed by the young professor.

The first attempt at laying a cable under the Atlantic was made by the Atlantic Telegraph Company in 1857 but the result was a failure. The second attempt was made in 1858. After a series of disheartening mishaps the telegraphic union of England and America was completed the morning of August 5, 1858.

Owing to the electrostatic capacity of the cable, signaling would have been difficult and unsatisfactory had it not been for the resourcefulness of Thomson, who devised his reflecting galvanometer. The principle of the mirror applied in this way was not new but Thomson was the first to insist on small dimensions in magnetic instruments, and to show that reduction in size would be attended with corresponding increase in sensitiveness. The mirror galvanometer, surrounded with a thick iron case to screen it from the magnetic field due to the iron of the ship, the "iron-clad galvanometer" as it was called, was used for the first time on the telegraphic expedition of 1858. The mirror galvanometer gave neither warning of the beginning of a message nor a permanent record of it. To obviate these drawbacks, Thomson finally patented the siphon-recorder, in which a glass siphon of capillary dimensions is pulled to the right or left by the action of the current flowing through a light movable coil, and is thus made to register signals in ink on a vertical strip of paper which is kept in uniform motion by clockwork.

Like all interested in the enterprise, Thomson, who had been aboard all cable ships, was greatly shocked when the news reached him that signals could no longer be transmitted through the cable. Attempts were made to raise it, but without success.

Another attempt at laying a cable was made in 1865. Leaving Valentia the cable ship successfully paid out 1100 miles, when the cable suddenly snapped and disappeared in more than two miles of water. Attempts made to recover it were unsuccessful and like its predecessors of 1857 and 1858, the cable of 1865 was finally abandoned to its fate. In 1866, Prof. Thomson was again on board the *Great Eastern;* and this time the cable that was destined to put Europe and America in permanent telegraphic communication was on board.

Shortly after his return, Thomson was knighted for his splendid services in connection with sub-oceanic cables, and was also honored with the freedom of the City of Glasgow.

If while journeying over land or sea, Thomson's mind was always active, his eyes were also open and observant. In the numerous voy-

ages which he undertook in the interest of cable companies, he was struck with the unreliable character of the ordinary apparatus used in taking soundings, consisting of a heavy weight suspended by a thick hempen cord unwound from a reel. Owing to the massiveness of the cord, motion of the ship and currents in the water would necessarily deflect it from the vertical, so that the soundings recorded would be in excess of the true depth. To remedy this defect, Thomson replaced the rope, at first by a steel wire, and later by a thin strand of steel wires, on which the speed of the ship has but little effect; the sinker descends vertically with considerable velocity, and is raised with equal rapidity by suitable winding-up machinery placed in the stern of the ship. The sinker carries a gauge consisting of a quill-tube open at the lower end and closed at the top. The inside which is coated with silver chromate, shows by the discoloration produced by the action of the sea water how far the water has compressed the air in the tube. By comparison with a graduated ruler, the depth is then read off. When the sinker reaches bottom, the heavy weight is automatically detached, so that there is but little strain on the wire as it ascends with its thermometer and battery of tubes containing samples of the depths reached.

Another subject to which Thomson gave some attention after his experiences on the ocean is the navigating compass. His observations led him to distrust the long heavy needles then in general use on shipboard. Besides the friction to which the pressure on the pivot gives rise and which necessarily diminishes the sensitiveness of the needle, there was another objection, due to the difficulty experienced in successfully applying steel magnets and soft-iron masses to compensate for the magnetism of the ship and for the changes induced in it by change of place in the earth's magnetic field.

As a result, Thomson devised a compass-card which was remarkable for its lightness and sensitiveness. It is made of two sets of magnets, containing four needles each, arranged symmetrically on the right and left of the pivot. The four needles, forming a set, are of unequal length, ranging from 3¼ to 2 inches, with the shortest outermost. Such a card, with its associated correctors of steel magnets and soft-iron balls, added greatly to the safety and certainty of navigation.

By special request, Thomson gave a course of lectures at Johns Hopkins University in 1884 to an audience of American men of science, twenty-one in number. A few years later, official recognition of his distinguished services and of his eminence in science came to Sir William Thomson when, in 1892, he was raised to the peerage, with the title of Baron Kelvin of Netherhall.

Kelvin gave a beautiful example to the world, when, after resigning the chair which he had occupied for fifty-five years at the University of Glasgow, he immediately proceeded to enter his name on the under-

graduate list, intimating by such an act that a man must ever be a student.

Lord Kelvin had the happiness of enjoying good health throughout all the years of his long career. In later years, however, owing to facial neuralgia, he was accustomed to spend a month or so every summer with Lady Kelvin at Aix-les-Bains, from which visits he always derived much benefit.

While making some experiments in a corridor of his beautiful home at Netherhall, he caught a chill on November 23, 1907, from which he never rallied.

Academical honors were showered upon Lord Kelvin by seats of learning, ancient and modern; he was a D. C. L. Oxford, LL. D. Cambridge, and a D. Sc. London; he was President of the Royal Society from 1890 to 1895; President of the British Association in 1871; Knight of the Prussian Order *Pour le Merite*, and Foreign Associate of the *Institut de France*.

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## MEASURING WELD DUCTILITY

Ductility has long been recognized as one of the most desirable qualities in weld metal, and there has long been a need for an easily applied method of determining this property. Even when samples were sent to a testing laboratory, the tests customarily made did not give any data on the true ductility of the metal in the weld.

Recent investigations at the Union Carbide and Carbon Research Laboratories have developed a simple bend test that makes the determination of ductility an easy matter. No special equipment is required and the test can be made right in the field or in the shop. Any welder can apply it to his own work and welding supervisors will find it valuable as another means of making periodic checks on welders' ability. In fact, a study of the method will repay everyone interested in good welds.

In the past there has been much discussion as to the relative ductility of welds made by various processes. As there was then very little in the way of actual data, these discussions continued without being conclusive. The new bend test offers a method for making direct comparisons among various types of welds. Application of this test will bring out some very interesting results.—Oxy-Acetylene Tips.

# How Lindbergh Got Across

*Bradley Jones, Dayton, Ohio**

LINDBERGH'S "We" has become famous. The plural pronoun leapt into prominence coincident with its user. When questioned by reporters "Lindy" explained that the "We" included the "Spirit of Saint Louis" with himself. Undoubtedly if he had been pressed for details, he would readily have agreed that "We" were really four, the airplane, the engine, the instruments and the pilot.

The sturdy Ryan monoplane, the reliable Wright engine, the various navigational and engine instruments and himself were all essential to the success of the epoch making flight. The airplane might have borne the load, the engine might have never missed, the pilot might have performed his functions correctly but if the instruments had failed or read wrongly,

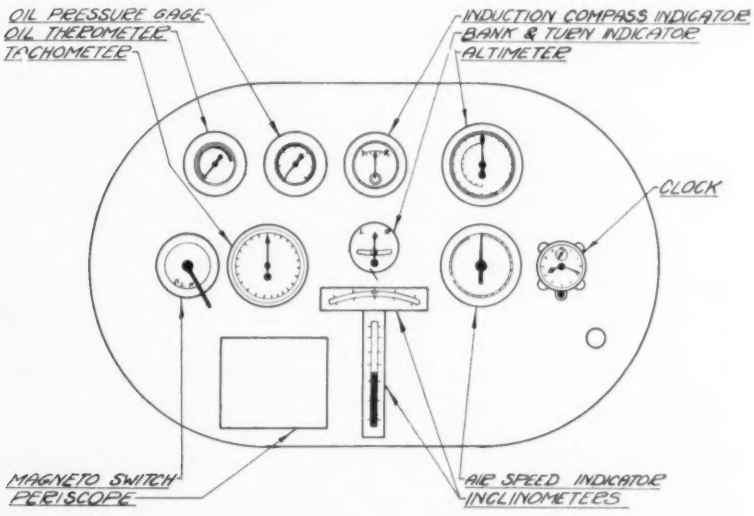


Fig. 1—Diagram of Lindbergh's Instrument Board.

disaster would have resulted. Success or failure depended as fully on the instruments as on the power plant, the aircraft or the aviator.

The epochal flight of Lindbergh appealed chiefly because of its unqualified perfection. The plans were for a hop to Paris and Paris, the goal was achieved even though the fuel tanks were practically empty on landing.

*Engineering Division, War Department Air Service.
Published by Permission of the Chief of Air Corps.

If, instead of having nine gallons to spare, Lindbergh had landed short of Paris for lack of fuel, the nicety of his performance would have been marred. Byrd's gallant flight while a truly magnificent feat, did not reach its objective, so the same recognition is not given to it as to the flight of the "Lone Eagle."

To the instruments was charged not only the duty of guiding the pilot through fog and night to the destination but the guidance had to be straight and true. Any wanderings from the shortest possible road to his destination would have used up the precious fuel needlessly, and there was no margin of safety in regard to gas supply.

A diagram of his instrument board is shown in figure 1. Much thought must have been put into its arrangement. It will be noted that in the center of the board are the four important "navigating" instruments, the compass, the turn indicator and the two inclinometers. During his 36-hour vigil he must watch these almost incessantly. The airplane was remarkably stable in flight so that, if the air was still, hands and feet could be removed from the controls for minutes at a time. If the nose dropped or a wing was thrown up, etc., the pilot would have to immediately correct for it. If the horizon was visible it served as a guide in

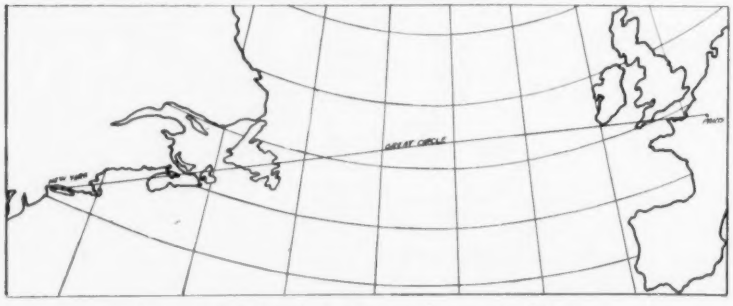


Fig. 2—Lindbergh Route on Gnomonic Chart.

flying horizontal but during the long hours of darkness and fog dependance had to be placed on the inclinometers.

One can swing a bucket of water around one's head and as long as the bucket is being swung fast enough, the water will not drop out. Centrifugal force must be great enough to overcome the force of gravity. In the same way an airplane may be looped and if the loop is properly executed, there is no tendency for the pilot to drop out. Centrifugal force holds him firmly against his seat, always provided that the airplane has had sufficient speed to carry him over.

On railways, the outer rail is always higher on a curve. If this were not done, the passengers would be thrown to the side of the car whenever the train rounds a bend. Since the track is banked, passengers do not experience this discomfort and do not realize they are not in a ver-

tical position. If one were standing alongside the track he would see the cars tipping inward as they went around the curve.

So in an airplane a wing may drop slightly and if this is accompanied by a slight turn, it will be unnoticed by the pilot. If the condition is not corrected, the bank becomes steeper, the turn becomes sharper, and the airplane is in a spin. Without a horizon visible, a spin is almost inevitable unless there are instruments to substitute for the horizon. Only a few minutes of darkness or fog would elapse before the pilot would lose all sense of vertical or horizontal without his instrumental aids.

The compass used by Lindbergh was a new type developed under the direction of the Army Air Corps. The old familiar magnetic-needle type compass is not entirely satisfactory for airplane use. If one brings a piece of iron or steel close to a magnetic compass, the reading is thrown off to a more or less degree depending on the size of the piece of steel and the distance away from the compass. In an airplane cockpit, it is practically impossible to put a cockpit where it will not be affected by the steel of the engine, the pumps, the tanks, the generator or the voltmeters. It is true that this local attraction may be neutralized by putting compensating magnets in chambers in the compass, but this usually tends to make the compass-needle very sluggish.

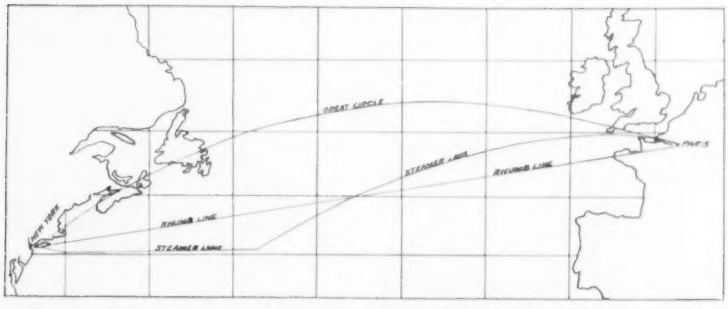


Fig. 3—Mercator chart of North Atlantic (The projection mostly used by mariners).

The induction compass, which was the type used by Lindbergh is a distant-reading compass. By this is meant that the compass may be read at a point at some distance from where the compass is located. In the Spirit of St. Louis, the essential part of the compass was far back in the fuselage away from the malign influence of the 485 pounds of steel in the engine.

On the instrument board, directly in front of Lindy was the indicator of the compass, which resembled a milli-voltmeter. If the nose of the monoplane went ever so slightly to the left of the desired course the needle of the indicator went to the left, and if the monoplane headed to the right of the course the needle went to the right of its zero. Handily placed in the cockpit was a dial on which the course could be set.

Lindbergh flew an approximate great-circle course, a mammoth curve starting from N. Y. and swinging up over Nova Scotia and Newfoundland and out across the Atlantic. Being a curve, the course was constantly changing so that while leaving New York the airplane flew in a direction 54° East of North as it travelled up the New England Coast, the course was more and more Easterly till when farewell was bidden to land at Newfoundland the course was 68°. Over the ocean the course had still to be altered to the right till after flying 1200 miles over the open sea the plane was flying due East. From there on still turning to the right the course was South of East, so that as the plane neared Paris it was flying 22° South of East.

In flying a constantly changing course another advantage of the induction type compass is brought out, that less mental effort is required on the part of the pilot. With the older magnetic-needle type compass must bear in mind a course for 35 or 40 minutes, and then the course altering by a degree he must remember the new course for the same length of time. With the induction compass, the pilot keeps the needle on zero with his rudder, whenever he wishes to change his course he adjusts his dial for one degree.

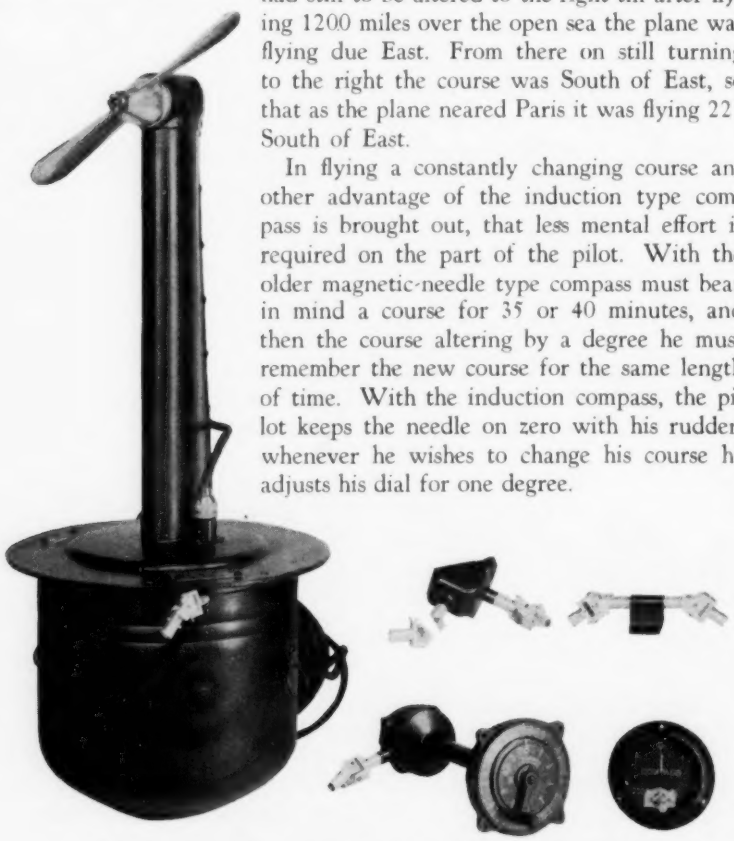

Fig. 4—Army Air Corps Type A-8 Induction Compass.
*Courtesy Army Air Corps.*

Of equal importance with his navigating instruments was his tachometer—on the careful regulation of his engine speed depended success or failure. The consumption of the Whirlwind engine is very sensitive to throttle opening. It may burn only 9 gallons an hour. It may burn over 30 gallons an hour. If the throttle is opened, the engine will turn over faster and the airplane will move faster through the air. The few extra

miles per hour gained in speed may be purchased at a frightful cost in added fuel consumption.

In an airplane, the wings have a peculiar curve in their cross-section. This curve is carefully designed so that as the airplane moves forward, the air going past the wing causes a lifting action. When the load is heavy, the airplane's nose is pointed up from the horizon, so that as the air strikes the wing at an angle so the vertical component is large. As the load decreases, the nose of the airplane may be dropped more nearly horizontal, as less of the engine horse power is needed to support the load and more of the power may be used to carry the airplane forward.

On carefully planned transoceanic flights, a schedule is prepared well in advance. This schedule is pasted up in the cockpit. It tells the pilot at any time during his flight just what speed his engine should be turning over and what his airspeed should be. It would be foolish to attempt to make high speed at the start when the airplane is loaded down with fuel. As the airplane lightens, it is better to throttle as the fuel consumption may be better conserved by maintaining a moderate speed rather than by speeding up.

The oil gage and thermometer both played their part in reassuring the pilot that he need anticipate no engine trouble.

Honors and plaudits have been accorded "Lindy." No one can deny his accomplishment of a wonderful feat. He has been termed the "Lone Eagle" because he flew alone. He preferred extra gasoline to having a companion who could act as navigator. He preferred more gasoline to carrying radio. A navigator could have checked position by the stars, a radio set would have enabled him to check on his position by bearing. Instead of these safeguards, he relied solely on his instruments and the trust he placed in these silent monitors was not betrayed.

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The Department of Scientific and Industrial Research, England, has been empowered to make tests at the public expense of plants for the low temperature carbonization of bituminous coal. The object of these tests is to place, in the hands of those interested, accurate technical data on the quality and quantity of yields, the throughput of the plant, the working temperatures, and the general ease of working, together with such other information as it may be possible to obtain under the limited conditions of the tests.

The present report describes a test of a unit "Crozier" retort erected in the grounds of the British Empire Exhibition at Wembley. The retort is of the continuously working vertical type, and is based on a similar plant erected in Burma for the treatment of oil shales. The coal used for the test was a Scottish splint coal, and, with the heating adopted, the throughput was about 4 tons per day.

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# The New Seismic Station at Fordham

*Prof. John W. Tynan, S. J., New York, N. Y.**

SEISMOGRAPHS are temperamental creatures and before they will work satisfactorily, many conditions must be fulfilled. At Fordham University experience has taught us some of the vagaries of the earthquake recorder and a complete new structure has been devised for the purpose of correcting them. Temperature variation, wind and industrial vibrations were the principal foes to be encountered and how we expect to overcome them is described below.

An easy solution to the problem of industrial vibration was at hand in the wide expanse of campus and the numerous quiet spots, far removed from roads which carried heavy traffic and also far enough from the elevated and electric railroad right of way.

To lessen the effect of wind vibrations and at the same time conduce to constancy of temperature, the main portion of the station was constructed underground. This consists of a chamber 20 by 40 feet, whose floor is 16 feet and its roof 4 feet below the surface of the ground. The walls are of reinforced concrete 18 inches thick and are covered on the outside by four-ply membrane waterproofing, overlaid with a half inch coat of waterproofed cement. The membrane water proofing consists of alternate layers of felt and asphalt; the felt being applied shingle fashion, with four thicknesses at every point. The roof, of the same construction as the walls, is 8 inches thick and is supported by 18 inch I beams.

The chamber contains six piers each designed to take a specific instrument. All the piers are concrete monoliths without reinforcement and are of the type called floating, that is to say, they are independent of the floor of the chamber. Excavations were continued until the base rock was uncovered. On this base the footings for the chamber walls and the pier bases were laid. The remainder of the base was filled to a depth of two feet with clay topped with ashes to carry the floor, which is of concrete. The floor is not attached to the walls, but is insulated from them by a two inch air space. Around the piers a three inch air space was left. The separation of the floor from the piers is intended to eliminate from the records, vibrations set up by the foot-falls of the observers or by any necessary mechanical work in the chamber.

The insulation of the walls and floor is expected to serve a dual purpose. Since the wall footings are on bed-rock and the walls are of very substantial construction, additional facilities may be made available, by attaching shelves to the wall to support recording devices. Another advantage is seen in the fact that should an unwanted vibration affect the walls of the station it could not be transmitted to the piers by way of the floor. This latter advantage is more obvious in the matter of diurnal tilt. In the previous installation, where the building walls were open to the rays of the sun and little provision had been made for temperature

*Director, Seismic Station, Fordham University.

control, it was found that as the temperature increased, the pendulum left its zero position and made constant progress in a given direction, so that in a very few hours the recording device had gone off the record. A decrease in temperature brought the pendulum back, but the return generally was not the exact reverse of the first motion. In the new installation, the underground position of the walls will minimize temperature change to a negligible quantity. But should the walls undergo contraction or expansion, their complete isolation from the piers should prevent them from having any effect on the instruments.

No thermostatic control of temperature is contemplated, because no heat will be installed. We shall depend for constancy of temperature upon our construction. The chamber, of course, will be kept closed—as far as working conditions will allow. The only opening to the out-

side air is a foot-square vent in the roof, which will be closed at all times save when necessity requires it to be opened. The door to the chamber will be either a heavy cold storage door, or a set of double doors. This will be at the foot of the stairway leading up to the surface building, which heretofore served as the station proper. The surface building is a single story granite structure 17 by 35 feet, with the entrance at one end. The stairway will come up into the opposite end.

It would have been a useless expenditure to go down deep enough with our cave to get away from surface vibrations, if we were to attach to the cave a surface structure exposed to wind and sun. Here we found our biggest problem. How to join the two structures and yet have them independent? A solution was found in the following manner of construction: The stairwell was poured as a unit with the cave walls and

brought out under the rear wall of the surface building. Inside this rear wall the stairwell was built up to the level of the surface building floor. The stairwell, from the chamber to the inside of the surface building was roofed over and waterproofed. The back wall of the building was supported by two piers either side of the stairwell, and surmounted by a steel beam above the roof of the well. An insulated air space of two inches was provided between the roof of the well and the supporting beam. The piers and outside walls of the well are separated by a five-inch sand cushion. The top of the well is separated from the surface building by a similar sand cushion.

That section of the surface building into which the stairway comes has been partitioned off and will be used as a combination darkroom and workroom. The remainder will serve as office space. A Wiechert 80 Kg Horizontal Seismograph will be mounted here to satiate the curiosity of visitors and, more seriously, to serve as a pilot for the more sensitive photographic instruments below.

All work is now completed and the new instruments on hand. Installation of these latter should be completed before the end of June. In the meantime the present equipment comprising two Milne-Shaw Horizontal Pendula will be installed. Despite handicaps these have given us excellent service in the past and with improved working conditions should show a corresponding increase in efficiency.

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# Electrical Standards**

*Prof. W. R. Work, Pittsburgh, Pa.**

NO ammeter, voltmeter or wattmeter can be relied upon to keep its initial accuracy indefinitely, even if it has not been subjected to abuse. In time magnets will weaken, springs alter in strength and resistance coils change in value. To insure accuracy in measurements made with these instruments, it is essential to calibrate them, from time to time, by comparison with suitable standard instruments of known accuracy. These standard instruments should be of a type and quality capable of high inherent and permanent precision.

In the United States the official custodian of the standards of weights and measures is the Bureau of Standards, a division of the Department of Commerce. The Bureau, in its Washington laboratories, maintains the legal electrical standards of the nation. To it any one may send precision instruments for test and comparison with the official standards. It is thus possible for a standardizing laboratory to base the accuracy of its work directly on the legal standards.

The International Ohm, so called because its size was agreed upon by The International Electrical Congress which met in Chicago in 1893, is regarded as the most fundamental electrical standard of measurement. For purposes of primary standardization, the ohm is defined as the resistance of a column of mercury, 106.3 centimeters long and weighing 14.4521 grams, at O°C. Mercury, rather than another metal was chosen because it can be obtained in great purity and because, being a liquid, it can not be subject to internal strains, which would slightly affect the resistance. For many reasons this form of standard is unsuitable for regular work, hence working standards in the form of wire coils are made. The wire is made of an alloy (manganin) which has a low temperature coefficient and a low thermal e. m. f. against copper. When properly made and aged such coils have shown great but not absolute permanence in value. They are adjusted by comparison, in a Wheatstone bridge, with a mercury ohm. With care, this comparison can be made to 0.001 of 1 per cent.

Having made and adjusted ten single ohm standards, a ten ohm standard can be made and compared with the sum of the ten single ohms and so on. This procedure results in a collection of standards of different values, the size of each being known as a multiple of the fundamental mercury ohm. Standards of fractional ohms are constructed by a similar process.

Resistance standards, one ohm or greater, furnished by reputable makers, are guaranteed to differ from the legal value by less than 0.01 of 1 percent. Standards 0.1 ohm and less are usually liable to an error of twice this amount.

The International Ampere, likewise adopted by the Chicago Con-

*Head of the Department of Electrical Engineering, Carnegie Institute of Technology.
**Lecture to be given before the Meter Course at the Carnegie Institute of Technology.

gress, is defined in terms of the amount of silver deposited from solution in one second. While this definition is entirely suitable for the purpose of establishing the legal size of the ampere, it is of no use in ordinary standardization; the technique is much too involved.

The choice of the ohm and the ampere fixes the size of the volt, for the fall of potential over one ohm carrying one ampere is one volt.

Although the primarily defined quantities are the ohm and the ampere, yet for practical purposes it is much better to base standardization work on the ohm and the volt. One of the reasons for this is that a standard ampere is not a thing which can be made and laid aside for future use; whereas a standard of voltage can be realized in the form of a voltaic cell.

Standard cells containing especially pure chemical elements have very permanent electro-motive forces. The voltage generated in any cell is that natural to the chemical elements employed, hence it is not possible to adjust the voltage of the cell to exactly one volt. Standard cells require very careful handling to insure retention of their accuracy; in particular, they must be so used that only minute currents can flow through them and then only for very short times.

The establishment and maintenance of a set of voltage standards presents much more of a problem than is involved in the case of resistance standards. In brief, one of several possible processes is as follows. A number of cells are made and prepared for standardization. A current from a storage battery is made to flow through a standard ohm and is adjusted in value until the voltage drop across the ohm is exactly equal to the e. m. f. of a cell chosen for test. The number of amperes, in the current is then numerically equal to the volts in the standard cell, and this number is determined in terms of the legal ampere by the silver deposition method.

A number of cells having been standardized in this way, they are, from time to time compared with one another by a potentiometer method so that the deterioration of any cell in the lot becomes apparent.

Modern standard cells have electro-motive-forces in the neighborhood of 1.0188 volts, with a practically negligible temperature error. They may be compared with one another on a potentiometer with an accuracy of measurement better than one part in 10,000.

Precision voltage measurements are made by means of a potentiometer and standard cell. The potentiometer itself contains a number of resistance coils, but no springs, magnets, or other parts which might alter in strength with time. Herein lies the great precision of the potentiometer for its resistance units may be accurately measured by comparison with fundamental resistance standards and they will hold their values constant for years. However, the calibration of a potentiometer may be permanently altered by allowing an excessive current to flow through one or more coils.

Since both potentiometer and standard cell may be calibrated to a precision of 1 part in 10,000, it is evident that voltage measurements made by a potentiometer can have an accuracy of about 1 part in 5,000. This amount of uncertainty is less than the width of the pointer on the scale of even a high-grade voltmeter at full deflection. In other words, a potentiometer will measure a voltage more accurately than a voltmeter can be read.

Precision current measurements are also made by means of a potentiometer connected to measure the voltage drop across a standard low resistance unit or shunt, through which the current to be measured is made to flow. Here also the precision depends upon the accuracy of standardized resistance units and a standard cell.

The over-all precision of current measurements, by the potentiometer method, is somewhat lower than for voltage measurements because, the precision of calibration of low resistance units is less than for high resistance units. Nevertheless, an accuracy of 1 part in 2,500 can be achieved and this is ample for the standardization of ammeters; the uncertainty is less than the accuracy with which the ammeter can be read.

Alternating current ammeters and voltmeters may be calibrated by direct current on a potentiometer, provided that they are constructed on the principle of the electro-dynamometer and it is known that the direct current calibration will be valid on alternating current.

The earth's magnetic field usually affects the indication of an electro-dynamometer used with direct current. To eliminate this error, two calibrations must be made, one for each direction of the current, the meter being in the same position on the table for both tests. Care should be taken in the arrangement of leads, particularly those carrying heavy currents, lest stray magnetic fields from them affect the meter indications. The average of the results of the two calibrations for any point will be the current value for that point.

Precision wattmeter standardization is carried out by simultaneous measurements of the current through and the voltage on the wattmeter, by two potentiometers. Direct current is used and a double calibration is made to eliminate the effect of stray magnetic fields, as explained above. If means are available for maintaining constant current and constant voltage, one potentiometer may be successfully employed in wattmeter calibration by using it alternately to measure current and voltage.

Standardization by potentiometer is a slow process and frequently gives a precision in excess of that needed. When there is much routine calibration to be done and an accuracy of 1 in 1,000 will suffice, use may be made of so-called laboratory standard ammeters, voltmeters and wattmeters. These are large instruments with long, easily read scales and are available in a variety of ranges. They should be periodically checked by a potentiometer.

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# Demand Totalizing by the Impulse Method**

*Carl Oman, Pittsburgh, Penna.**

THE consumer of large blocks of electrical energy frequently has a rate schedule which is based on the maximum demand of his entire installation, and it is often necessary to add the demands of a number of different circuits in order to arrive at the grand total. If this must be done by taking the charts of the various meters and selecting the readings which will give the maximum total, the work involved is appreciable as it is probable that the maximum demands of the various circuits did not occur in the same time interval, and it is necessary to select the interval in which the grand total of all the readings is a maximum. Equipment which will automatically totalize the readings is very desirable and in many cases almost necessary if good will is to be maintained between power company and consumer.

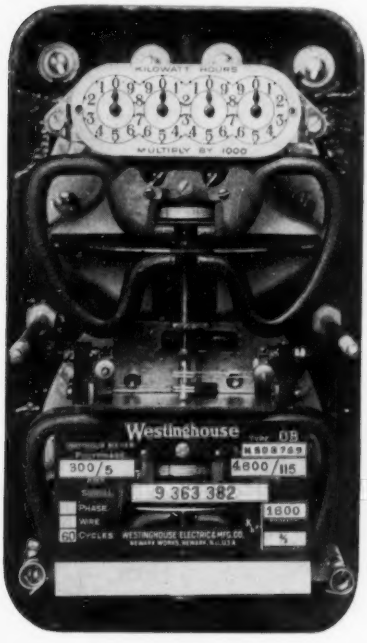



Fig. 1—Watthour meter equipped with contacts. The contact mechanism can be seen near the center of the meter.

In some installations the customer's plants may be several miles apart and in order to totalize, the meter indications must be transmitted to some central point. The solution of this problem of transmitting and totalizing as worked out by the Westinghouse Co. is called the "low rate impulse system" and the general principles of operation are given in the following description.

First consider a simple system having only one circuit to be metered. A watthour meter is equipped with a contact making mechanism either in the register or on a separate gearing driven by the main shaft of the meter. These contacts close and open at a rate proportional to the speed

*Westinghouse Electric & Manufacturing Company.
**A lecture to be given before the Meter Course at the Carnegie Institute of Technology.

at which the meter rotates. The operation of the contacts cause direct current impulses to be sent through the operating coil of a notching relay which actuates the register mechanism of a demand meter, each make and break of the circuit causing the relay to move the demand register forward one notch. Fig. 1 illustrates the watthour meter. The contact mechanism can be seen near the center of the meter. Fig. 2 shows the impulse operated demand meter. The notching relay can be seen just above the register.

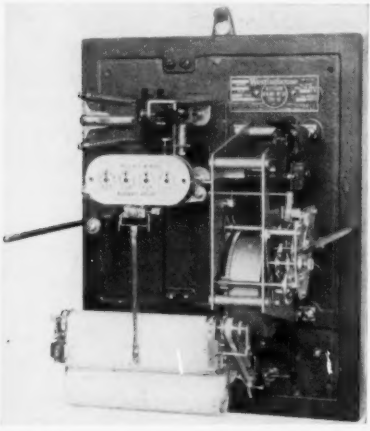


Fig. 2—Impulse operated demand meter. The notching relay can be seen just above the register.

If several watthour meters were equipped with contacts and connected to the same demand meter, the notching relay would move the register forward a number of notches equal to the total number of impulses sent out from the several meters, provided the impulses did not occur at the same time. If, however, a number of impulses should occur at the same time they would register only as one impulse and the total reading would be in error. This difficulty is overcome by using a chain of small reversing relays and a supervising distributor relay. These distribute the impulses so that only one at a time can enter the notching relay of the demand

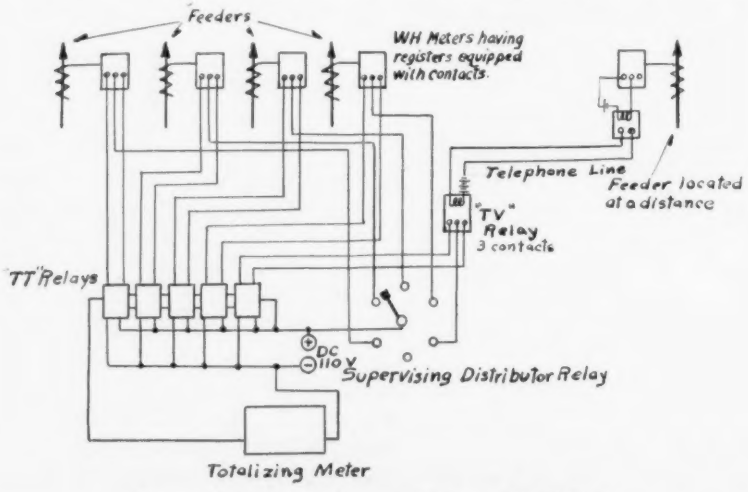



Fig. 3—Schematic diagram of Demand Totalizing Equipment.

meter. Such a system is schematically shown in Fig. 3. The watthour meter connections are standard and for simplicity these connections have been omitted from the diagram. Each meter is shown equipped with three wire contacts which operate one of the type TT reversing relays. The type TT relays are similar to those used in automatic telephone work and have a number of contact fingers so that the desired combination of circuits can be obtained. The TT relay is illustrated in Fig. 4. The supervising distributor relay is in principle nothing more than a number of contact switches which are opened and closed in sequence by a cam shaft driven by a small motor and is shown in Fig. 5.

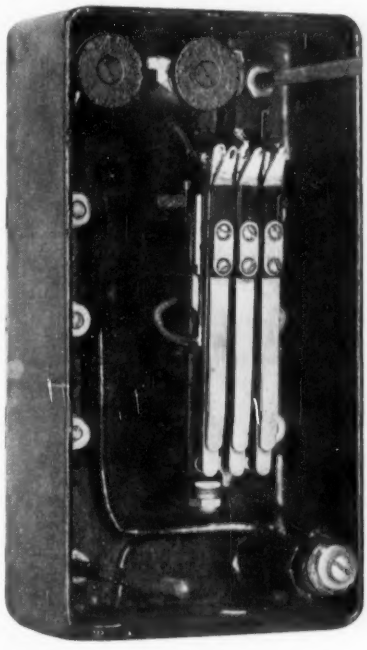


Fig. 4—TT reversing relay.

The manner in which any one of the watthour meters operates its TT relay is illustrated by the diagram in Fig. 6. When the right hand contacts close the relay pulls in and when the left hand contacts close the relay drops out, first throwing the reversing switch one way and then the other. The plus side of the line is connected to the mid contact of the meter. When it closes the circuit to the right the voltage is impressed across the operating coil and its series resistance, causing the relay to pull in. When it pulls in it closes a circuit through a pair of contact fingers inside of the relay as shown on the diagram. When the meter contacts open the relay does not drop out because the circuit is still closed through the fingers. When the meter contacts close on the left the operating coil is shorted out of the circuit leaving only the resistor across the 110 volt, consequently the relay drops out.

Referring back to Fig. 3 it will be noted that the mid-contact of only one meter is connected to the circuit at a time. This is done by means of the supervising distributor relay. Hence, if the contacts on several meters should close at the same time the TT relays will not operate all at once but in the order in which the distributor relay connects the mid-contacts to the circuit. It is obvious that the contacts in any meter must remain closed a sufficient length of time to permit the distributor relay to close the circuit belonging to that meter. This is done by designing the contacts so that they will remain closed as long as possible during a

cycle of operation and also making the speed of the cam shaft of the distributor relay sufficiently high so as to be absolutely sure of the circuit closing before the meter contacts open, even when high overloads are on the circuits.

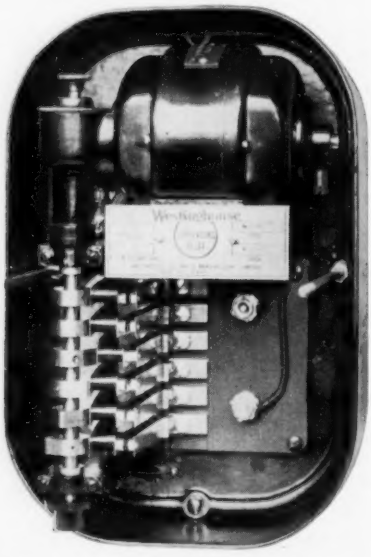


Fig. 5—Supervising Distributor Relay. The contacts are closed and opened in sequence by a cam shaft driven by a small motor.

Also, it is not possible for a TT relay to operate more than once while the meter contacts are closed in any given position. Referring to figures 3 and 6, assume the right hand contacts of one of the meters to be closed. When the distributor relay closes the circuit to that meter the TT relay pulls in and because of the fingers closing inside the relay it stays in regardless of the number of times the distributor relay may make or break connection with the mid-contact because the circuit is still closed through the fingers. When the contacts are closed on the left the TT relay will drop out as soon as the distributor connects to the mid-contact and it stays out because the fingers opened and there can be no circuit through the operating coil until the contacts have again closed on the right.

From the foregoing, it is seen that for every contact closure in the meters there is an operation of one of the TT relays, either in or out, also only one operation can occur at a time.

As previously mentioned each TT relay operates a reversing switch so that when the relay pulls in it throws the switch one way and when it drops out it throws the switch the other way. All of the reversing switches are connected in a chain in series with the notching relay of the demand meter. When any switch reverses the circuit through the demand meter is either made or broken, a make and a break moving the register forward one notch, consequently the register must move forward an amount proportional to the sum total of all the impulses sent out by all of the meters.

The operation of the TT relay chain is not as complex as it may at first seem. It may be likened to the common lighting circuit in which a light may be turned on or off from any number of different points. The diagram shown in Fig. 7 is self-explanatory. Regardless of which switch is thrown the light is either turned on or off. In exactly the same man-

ner the reversing of the relays cause the demand register to move forward.

If a meter is an appreciable distance from the central point, the impulses may be sent over two wires instead of three, but in order for its TT reversing relay to operate an auxiliary three contact relay must be

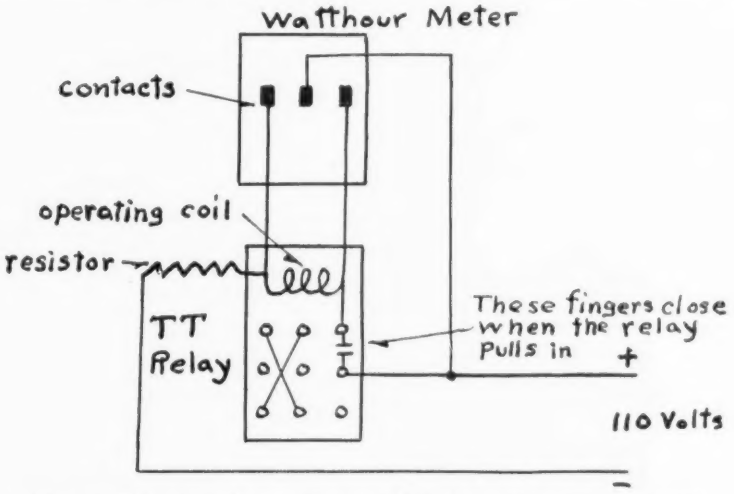



Fig. 6—This shows the manner in which the meter contacts operate the TT reversing relay.

used at the receiving end of the line as shown in Fig. 3. Existing telephone lines may be used for transmitting the indications and by using the phantom circuit the impulses will not interfere with telephone conversation. Fig. 8 illustrates the use of the phantom circuit.

When totalizing, it is important that the kilowatthours per impulse

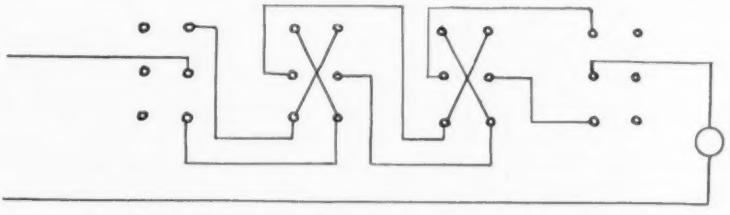


Fig. 7—The light may be turned on or off with any one of the switches.

be the same for all meters, and when the meters are used with instrument transformers having different ratios, the impulses may readily all be brought to the same value by selecting different gearing or different number of segments for the contact mechanisms. The impulse rate is always kept relatively low, seldom more than twenty impulses per min-

ute for the highest capacity meters at their full load. An impulse is here defined as a complete cycle of operation of a three wire contact, and is sometimes called a double impulse.

The foregoing explanation has given the basic principles of operation. The method is very flexible in its possibilities of application and can be extended to take care of almost any combination of circuits. The number of circuits that may be totalized is theoretically unlimited. When it is desired to totalize a large number of circuits, the circuits may be

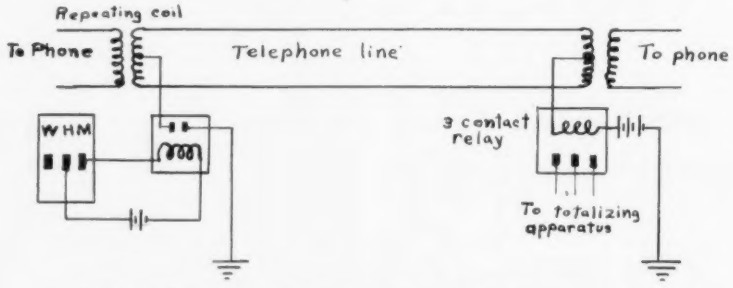



Fig. 8—The phantom circuit may be used for transmitting the impulses.

divided into groups, each group totalized, and totals of the groups totalized. Such an arrangement eliminates the necessity of the distributor relay having a great number of cams, it being possible with an eight cam relay to readily totalize sixty-four circuits. Every customer's installation has its own peculiar requirements and seldom two sets of equipment can be exactly the same, but the flexibility of the impulse system makes it applicable to practically any condition that may arise.

———— : : ————

The managers of industry and commerce can play a prominent part in maintaining prosperity by meeting their full responsibility in relation to standardization and simplification. The standardization of noncompetitive commodities and parts is conducive to mass production, low unit costs, high wages, and satisfactory profits. Proper standardization does not violate individual initiative, does not impede progress, or make all women wear the same kind of hat, shoe, or dress. It is a sane economic process.

Simplification is a significant factor in maintaining prosperity; consequently the industrial and commercial managers of this country should actively support the work of the Department of Commerce in this regard. Likewise they should continue to contribute to the national movement designed to eliminate unnecessary waste from American life.—L. W. Wallace.

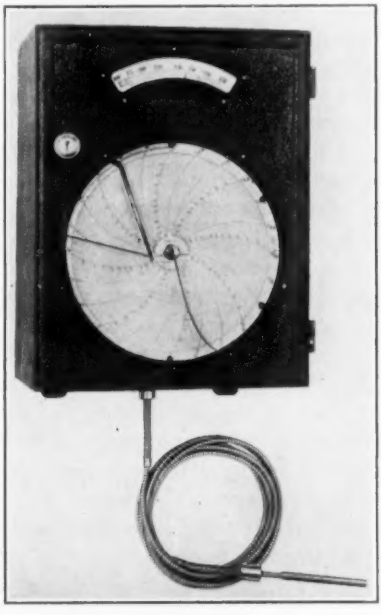
## New Instruments

**Recently Developed by Instrument Manufacturers**

# A New Combination Recording and Controlling Instrument

*(The Bristol Company)*

A TRAVELER tells of a small town in Asia Minor, where upon his daring to doubt the accuracy of the town clock, its custodian assured him of its infallibility on the ground that it was in perfect agreement with the noon gun at a nearby barracks. When his curiosity prompted him to enquire of the military authorities as to their standard of time, he was informed that the noon gun was each day fired in accordance with the indication of the town clock!



Such a condition has attended most of the efforts heretofore made to produce an instrument which in one unit would incorporate the combined features of regulation and measurement. Any cause interfering with the accuracy of regulation would be embodied to the same extent in the indicating or recording elements with the result that the instrument would "falsify its own accounts," and automatically cover up the discrepancy, making it possible for undesirable conditions to develop and continue indefinitely without detection.

In an indicating or recording instrument, moreover, every effort must be made to remove all interfering forces on the pen or pointer; and even the slight friction of the pen on its chart must be kept at an absolute minimum, or errors may be introduced into the readings In the controlling instrument, on the other hand, the deflecting pointer is required to act as a relay, and by means of contacts or otherwise to effect the operation of valves or switches. Unless, therefore, the instrument itself is of

the relay-operated type, the pointer is called upon to perform certain work; and even though this be but to close the lightest form of contact, it is impossible to accomplish the result without the indicating element departing from its true reading, due to the mechanical reaction of the contact.

Realizing the handicap thus placed upon a device attempting to accomplish both results in a single element, The Bristol Company, which has long been supplying separate instruments for both purposes, has concentrated its efforts on a method of combining in one unit the functions of measurement and control, and at the same time eliminating the objectionable features which have heretofore attended the combination. As the outcome of this development there is now being offered in a rugged and compact form a new instrument, known as the Model 67, embodying in a single unit a recording instrument and a contacting controller.

The Model 67 Recorder-Controller is available in either a single-pen or two-pen form. As may be seen from the accompanying photographs, it combines a round-chart instrument identical with the well-known Bristol recorder, and immediately above it, on the same mounting, a contacting controller with an index and scale. Each of these is actuated by a Bourdon tube in the form of a helical spring; and, while the two pressure elements are entirely separate and independent in their operation, they are identical in structure and connected through a common capillary tube to a single sensitive bulb. By this arrangement, the deflecting elements of the recorder and controller operate as individual units, but are subject to the same controlling temperature or pressure.

By complete separation of the regulating and recording functions, it has thus been made possible to employ relatively rugged direct-acting contacts in the control circuit; and the record is not in any way affected by the retarding effect of this part of the mechanism. The pen is left free to move at all times; and the record is made at points above and below the control setting without impairment of accuracy.

The main operating contact of the controller is carried by a light rigid counterweighted arm mounted directly on the shaft of the actuating pressure spring without links or any interposed mechanism to interfere with sensitivity. The upper and lower contacts, between which the main contact plays, are permanently set to the proper spacing and affixed to an adjustable arm which terminates in an index on a graduated scale. The contacts are of selected material, mounted upon suitable supports, and insulated from other metal parts by plates of bakelite. The supports are disposed so as to produce a wiping action between contacts; while the design of the insulators prevents accumulation of foreign material and facilitates inspection and cleaning. All internal wiring is heavily insulated. By the use of self-contained automatic switches carried on the rear of the supporting plate, the control circuits are given a contact capacity of 1,000 watts, simplifying the use of the instrument in many applications where the use of additional relaying devices would

introduce complication and materially add to the expense. Separate zero adjustments are provided for controller and recorder pressure elements; and these are secured in such a manner that they cannot accidentally be disturbed.

The whole mechanism is mounted on a massive aluminum plate, with terminals for electrical connections conveniently arranged. This unit is contained in a strong steel case; and the mounting is such that it may easily be removed for inspection of parts at the rear of the panel, without any disturbance of adjustments. Heavy lugs at the top and bottom of the case facilitate installation on a wall or other support.

The operation of the device is extremely simple. The recording element differs in no detail of manipulation from the well-known Bristol round-chart recorders. In the use of the controlling system it is necessary only to set the index to the desired point on the scale; and, as both pointer and scale are of generous length, the setting may be effected with ease and precision.

Because of the ample contact capacity of the instrument, it is possible to directly operate small motors and heaters, as well as motor and solenoid operated valves without the interposition of relays; and while the electrically operated circuit breakers and magnet switches are used in industrial processes and heating installations, may have their opening and closing coils energized directly from the terminals of the controller.

The Model 67 Recorder-Controller is available in a wide range of pressures and temperatures; and finds a very wide field of application. By way of suggestion there are mentioned such uses as the control of ovens for baking, japanning and enameling and for the baking of bread and cooking of other foodstuffs; the pasteurization of milk; the preserving and canning of fruits and vegetables; the regulation of temperature in chromium plating; the maintenance of proper atmospheric conditions in dry kilns, textile mills and other places where temperature and humidity play a part in the quality of the product; as well as in a great variety of low temperature annealing processes.

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John Frederick Daniell, a chemist of London, England, introduced the expansion pyrometer in 1822, using a platinum rod encased in plumbago and equipped with a device for moving a pointer over a scale.

Uehling and Steinbart pyrometer was invented in 1894. Its first special adaptation was for the blast furnace use.

Jacquerod and Perrot about 1905 made extremely careful determinations to increase the accuracy of pyrometric measurements.

Holborn and Valentiner in 1906 made careful determinations to extend the gas thermometric scale in pyrometric measurement from 1105 to 1600° C.

# Information Section

**Correspondence from instrument users and others pertaining to or relative to instruments**

THIS section invites correspondence from instrument users and others relative to questions pertaining to instruments. If our own editorial staff should feel that any question submitted cannot be readily answered, we will obtain the necessary information from some of our collaborators. Thus the greatest experts are at the disposal of our readers in assisting them in the solution of their instrument problems.

Names and addresses of manufacturers of instruments will be furnished on special request. Inquiries pertaining to sources of supply should be addressed in writing to our Information Section. Such inquiries will be answered promptly by mail.

Inquiries regarding instrument problems will be answered by publication in this special "Information Section" of INSTRUMENTS. We feel that other besides the inquirers may be interested in the same or similar problems, and in this way all of our readers will obtain the benefit of the information furnished.

No. 1. We are at the present time looking for an instrument for detecting noises in ball bearings. We are wondering if you have any information in your files about concerns which make instruments, which could be used on a production basis, for detecting noises in bearings?—V. W. F.

No. 2. Can you put us into communication with the manufacturers of the Howard-Dolman Depth Measurement Instrument?—E. F. H.

No. 9. Kindly furnish me with reference for an electrical instrument for detecting water leaks.—L. L. T.

No. 13. We would be pleased to have you notify us where we can obtain jewels for indicating meters, F.

No. 14. Who is a maker of an indicating or recording instrument for chlorine gas mixture with $N_2$, $O_2$ and possibly some $H_2O$? The chlorine content varies from 0—50%.—T. C. W.

No. 15. We are looking for a device to indicate and possibly record low pressure differences. The values range from zero to 25 millimeters of water and we desire to read the pressures to one tenth millimeter fairly accurately.—A. A. G.

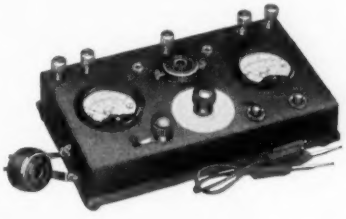
No. 16. Could you send us the names of dealers who handle apparatus for measuring linear expansion, particularly the linear expansion of thin metal foils?—D. H. H.

# New Hoyt Universal A. C. and D. C. Tube Tester

*(Hoyt Electrical Instrument Works)*

WITH the advent of A. C. operated radio sets and the use of relatively high filament and heater currents for the tubes used, a different sort of testing device for checking the elements of these tubes is needed. The Hoyt Universal Tube Tester does the work and at the same time offers a number of distinct advantages. It is small and light so that it may easily be carried on a service call. The especial interesting feature though, is the fact that it may take its operating power from any one of the three sources:

1. batteries, 2. the A. C. line, 3. a radio set tube socket.



A filament transformer of standard design can be used as "A" supply for testing A. C. tubes, or a battery may be used as desired. Provision is made for testing all types of tubes, including tubes with top heater connections such as McCullough, Kellogg, etc. A dry "B" battery is recommended as plate supply. (An eliminator can be used if the voltage is carefully checked on a high resistance meter when it is being used.)

A tube base plug with four leads can be supplied, which when it is plugged into a receiver tube socket operates the tube tester from the receiver power supply. This arrangement makes the Model 400 especially useful on the outside service jobs.

The tube tester can be used for reconditioning radio tubes if the dealer wishes to follow the method of slow reactivation sometimes suggested. With the tube inserted but no B-voltage connected to the plate, any desired voltage can be impressed on the tube filament by the use of the rheostat: Submit the filament to a voltage slightly higher than its rated value (see table) and allow the tube to burn thus for about two hours. This operation gradually drives to the filament surface the thorium with which it is impregnated. Then reduce the voltage by the rheostat, to the rated value and leave for several hours. The tube can be tested at intervals to see how well it is returning to the proper condition.

Only tubes with thoriated tungsten filaments can be reactivated. These are shown in the table below with their rated filament voltage and suggested reactivation voltage. Either direct or alternating current may be used.

| Type of tube | | Rated filament voltage | Reactivation voltage |
|---|---|---|---|
| UX 199 | CX 299 | 3.3 | 4.0 |
| UX 120 | CX 220 | 3.3 | 4.0 |
| UX 201-A, | CX 301-A | 5.0 | 7.0 |
| UX 200-A, | CX 300-A | 5.0 | 7.0 |
| UX 240 | CX 340 | 5.0 | 7.0 |
| UX 271 | CX 371 | 5.0 | 7.0 |
| UX 210 | CX 310 | 7.5 | 9.0 |

If the operator wishes to make complete tests on vacuum tubes, there are three sets of curves which he should plot and from which certain information can be obtained:

1. The Grid volts-plate current curve, from which he can learn the general characteristics of the tube and decide where it should be placed in the set.

2. The Grid current curve, which is drawn for tubes to be used as detectors.

3. The Emission curve, for determining the correct filament voltage of the tube.

Of these three, the first is quite commonly used, and for plotting such curves the Hoyt Model 400 is adapted. A complete description of the method is given in the Hoyt Bulletin.

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More than 50 years ago, when testing was rather a new idea, A. H. Emery designed and built a testing machine for the War Department. It was installed in the year 1875 at Watertown Arsenal and has been in use ever since. Upon the completion of this machine, a series of studies and experiments on physical testing devices was begun which culminated in the splendid examples of precision machinery now being used at the Bureau of Standards.

Type 515 Portable Voltmeter

Hoyt Portable Meters

This accurate, hand-calibrated Portable Voltmeter is a typical example of the complete line of fine portable Hoyt Meters.

Hoyt meters have been built since 1904, to fixed standards. Made in all styles—Voltmeters, Ammeters and D. C. Voltmeters.

*Write us for complete Catalog "Hoyt Portable Meters."*

Hoyt Electrical Instrument Works
857 Boylston Street Boston, Mass.

# Semi-Suspended Microammeter

***(Rawson Electrical Instrument Co.)***

SPEAKING of High Sensitivity Electrical measurements usually carries with it the impression of the necessity for a combination of more or less delicately constructed pieces of apparatus such as the Reflecting Galvanometer with its anti-vibration mounting, leveling device, lantern and scale to be used in a shaded position and calibration made of deflection after each rest period due to the possible slight shifting of lantern or scale when not in use. All circuits under test must be carried to the above on account of the lack of portability of the testing apparatus; or using somewhat Oriental language, If Mohammed won't come to the mountain, then the mountain must come to Mohammed.

The recent further development of the Rawson Electrical Instrument Company's type 503, Semisuspended meter now makes it possible to obtain a portable meter which can be used anywhere without auxiliary apparatus and needing only an approximately level box, bench or floor to rest upon. The meter itself needs no leveling, as it is carefully balanced on its single pivot, from which however the weight of the movement has been lifted by adjustment of the suspension control.

Hand calibrated deflections which will stay constant to the order of .000,000,005 ($5 \times 10^{-9}$) ampere or .005 microampere per division can now be supplied on a meter having a resistance of approximately 6000 ohms. When thinking in terms of insulation this is equivalent to a sensitivity of 200 Megohms, or in other words, a deflection of one division is obtained through a resistance of 200 million ohms when applying a potential of one volt. When using 500 volts which is a common insulation testing potential one division deflection would be equivalent to 100,000 million ohms. If requested the meter can be calibrated to read Megohms at a specified voltage. The same meter is also useful for measurement of grid current in radio circuits.

Numerous other uses will suggest themselves such as, Peak Voltage measurement where the meter is shunted with a condenser and a Vacuum Tube is in circuit. As a D. C. Voltmeter this should be made up to a sensitivity of over two million ohms per volt. This would truly be one which would not load up the circuit to any great extent. Investiga-

tion into atmospheric potentials can also be easily done with this. Mr. C. L. Kasson of Boston recently made some very interesting speculations relative to electrical balance and disturbance in the atmosphere by placing one of this type of meter in series with an antennae, every other circuit being disconnected therefrom, surprising results followed.

Investigation of Earth Currents also calls for a very high resistance voltmeter. This is necessary on account of the very high resistance of the non-polarizable electrodes used. In the McCollum Earth Current Meter one having a resistance of one million ohms per volt is used.

As a thermal instrument, when used in connection with sensitive Rawson Thermocouples in vacuo a movement having a resistance of ten ohms is used, which is the one more nearly the average junction resistance. Full scale reading can then be obtained with a current of 500 microamperes, reading down to the lowest calibrated point, 100 microamperes. This calibration is obtained when using a normal two milliampere junction with heater resistance of approximately 750 ohms. Putting this another way the normal sensitivity of Thermocouples can be increased four times by using the meter. The great advantage gained being much lower current reading using same resistance heater or much lower resistance heater for same current reading. In other words there is a saving of fifteen-sixteenths of the wattage used by meter combination and extension of overloading capacity on heater to 600% as against a 50% overloading on normal range of thermo junction. There is, however, what some might consider a serious disadvantage in using this combination and that is its very slow action due to overdamping of movement when connected direct to junction. The time from zero to maximum full scale reading being from 45 to 60 seconds. This time can be shortened at the expense of sensitivity by addition of series resistance to couple and meter circuit. Although the readings are slow they are however very positive.

Multiple ranges can be supplied either as straight DC or as Thermal meters for AC or DC. For instance for DC a six range meter reading full scale for 1-10-100 microamperes and 1-10-100 milliamperes, while as a voltmeter, having a resistance of one million ohms per volt, full scale ranges for .01-.1-1-10 volts.

Biological research is also aided by this as much lower temperatures as measured by thermopiles when investigating light rays in lakes, etc., can be obtained.

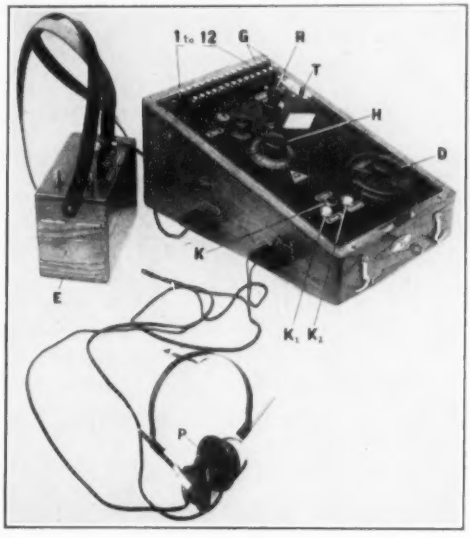
This same type of meter can also be supplied with differential winding, two separate circuits on same movement. Application of this old established principle may suggest other uses for this very unusual meter.

# New Maihak Acoustical Strain Gauge

(*Bacharach Industrial Instrument Company*)

THE Maihak Acoustical Strain Gauge was designed for the measurement of the strain and accompanying stress induced in machine parts (flywheels, propellers, shafts), steel structures, foundations, bridges, etc., acted upon by live loads or superimposed loads and dynamic forces.

The measuring principle is based on the fundamental law that the pitch of an oscillating steel cord is proportional to the stress within the cord. Hence, if a steel cord is attached to the test piece and set into oscillation, the degree of deviation of the pitch before and after deformation of the cord is a direct measure of the magnitude of stress thus produced.




The determination of the pitch of the oscillating steel cord attached to the test piece is accomplished by adjusting a test cord to oscillate at the same pitch as the cord on the test piece. The stresses thus produced in the test cord can be directly read off from a dial. If test piece and cord attached to it are of the same material (steel), the dial reading gives directly the unit stress induced in the test piece by its deformation. If the test piece is of different material than steel, the modulus of elasticity and cross-section of the object has to be taken into account.

Temperature changes within the range to which machine parts or structures are subjected under ordinary conditions do not influence the results, provided the object is of steel. If it is of different material than steel, the reading must be corrected by a factor which takes the coefficient of linear expansion of the object into account.

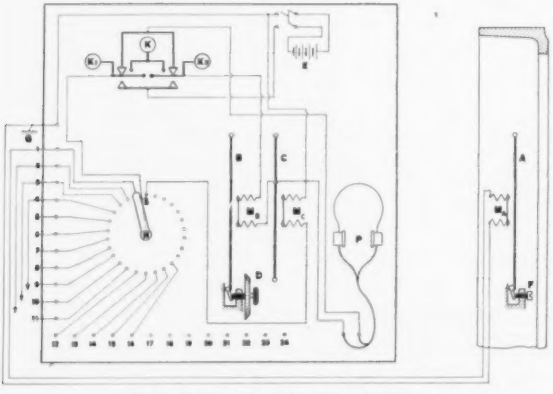
To accomplish quick and dependable measurements at any distance from the test piece, the sound waves of the steel at the Testing Station are converted into electrical waves of the same frequency, which are transmitted over a wiring system to the Receiving Station. At the Receiving Station, the electrical waves are reconverted into sound waves and audible as such over an ear phone. A vacuum amplifier tube may or may not be used for amplification of the audible waves.

## Principle of Operation

The principle of operation of the apparatus is evident from the wiring diagram. By closing contact "K1," magnet "MA" is energized and the cord "A" is drawn against the magnet. If the switch "K1" is opened, the electrical circuit is broken and the cord is set into oscillation. In a similar way, the test cord "B" is operated by a switch "K2"; master cord "C" is operated by switch "K1" after handle "H" is turned to station "S." Cord "A" and "B" may be operated simultaneously by switch "K."

Before the test, cord "A" and "B" are tuned up to oscillate at the same pitch as the master cord "C." This is done by stretching the cords by means of set screw "F" and dial screw "D."

When the live load is impressed upon the test piece, the latter under-



—WIRING DIAGRAM OF MAIHAK STRAIN GAUGE—

goes a deformation, causing a change of the stress and consequently of the pitch of the cord "A."

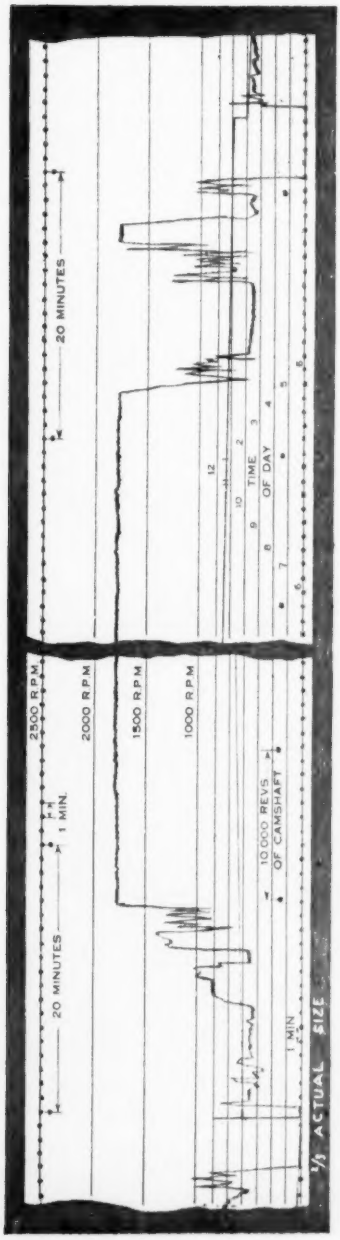
The cord "B" is then adjusted to the same pitch as cord "A" by means of the dial screw "D." The reading on the dial gives directly the stress in pounds per square inch induced in the machine part, due to its deformation.

Some of the outstanding features of the Maihak Acoustical Strain Gauge:

(1) Twenty-four measuring points can be connected to one receiving station.
(2) Light weight of testing device attached to object (steel tape).
(3) Results not influenced by vibration of test object.
(4) Simple installation.
(5) Maximum measurable unit-stress=50,000 lbs./sq. in.
(6) Unit of dial reading=25 lbs./sq. in.
(7) Elongation may be measured with an accuracy of .000005 inch.

# The Hasler Tel Recorder for Aircraft

*(R. W. Cramer & Company)*




OF the various instruments required on aircraft, one of the most important is that which gives the speed at which the engine is running. A simple indicating tachometer, if reliable, is a good guide to the functioning of the engine, on which the safety of the aircraft mainly depends. The utility of the instrument is greatly increased if it can also furnish a permanent record of performance and operation on a time basis.

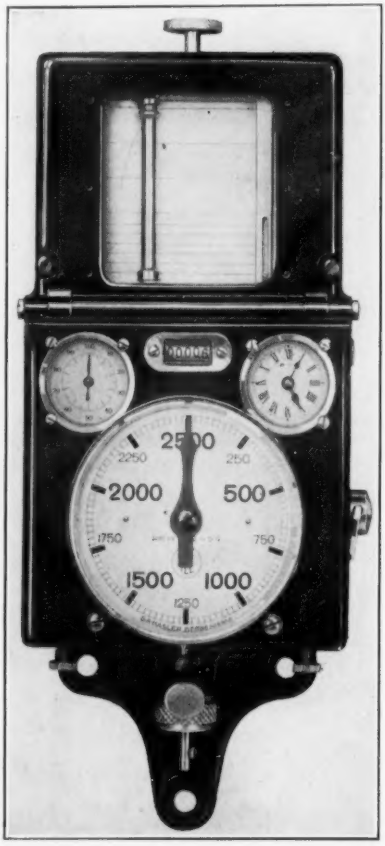
Such records would obviously provide valuable information in connection with the investigation of an accident, would greatly simplify the task of the management in the accounting of flights and in maintaining schedules, and would provide operating data valuable to the general administration of the air line.

The function of this instrument is to furnish on a chart a permanent record of the following operating information:

1. Engine speeds attained every second.
2. Time and duration of flights.
3. Time and duration of stops.
4. Time of day, in hours and minutes.
5. Flight hours.
6. Idle time.
7. Trip revolutions.
8. Total revolutions.

In addition, it indicates to the pilot the true speed development of the engine and how it is functioning, and the time of day.

The instrument is shown in the illustration. The recording paper moves at a set speed and ceases to travel 5 minutes after the engine stops. Therefore, during operation, the time line, which is marked by a scriber connected with the clock, is an oblique line, ascending from 6 to 12 o'clock and descending from 12 to 6 o'clock. The time line becomes vertical when the engine is not running. The exact hours are indicated by the points at which the time line crosses the parallel lines printed on the paper. The minutes are marked by closely spaced dots at top and bottom. To facilitate reading of minutes, every twentieth is marked by a double dot. The engine speeds are recorded by another scriber connected with the speed indicator, and any point on this graph represents the engine speed attained that instant.




Every 10,000 revolutions of the camshaft are recorded by a dot in the lower part of the chart. The number of these marks during any flight multiplied by 20,000 represents, therefore, the total revolutions made by the engine during the flight.

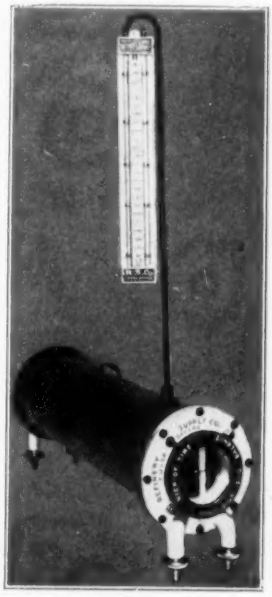
The total revolutions accomplished by the engine, from the time of installation, are registered in units of 20,000 on the roller type revolution counter directly above the dial.

A portion of a flight record, during which the engine speed was practically constant for a period of 1 hour and 50 minutes, has been omitted. From this chart it can be seen the engine was started at 10:00 o'clock, and stopped at 1:00 o'clock, a total running time of 3 hours. The engine speed variations in the course of warming up, taking off and landing, are shown; also that the actual flight started at 10:15 and ended at 12:59. The chart shows that, previous to taking off, the plane ended a flight at 5:55 o'clock the previous day.

# A New Precision Specific Gravity Gas Balance

*(The Refinery Supply Co.)*

GREAT strides have recently been made in the gas industry in connection with the determination of Specific Gravity of Natural Gas through the perfection of a Gravity Balance.



The idea of the balance is a development of many years of experiment on the part of many individuals, and companies in the Mid-Continent and California Fields, the idea being to obtain the weight of the various gases as compared to the weight of an equal amount of air. Various ideas were developed which while giving a fairly accurate measurement were either slow in operation or too delicate to carry for the use of the field man. Samples could be brought into the laboratory and checked but in main balances were not used because of slowness of operation or other difficulties.

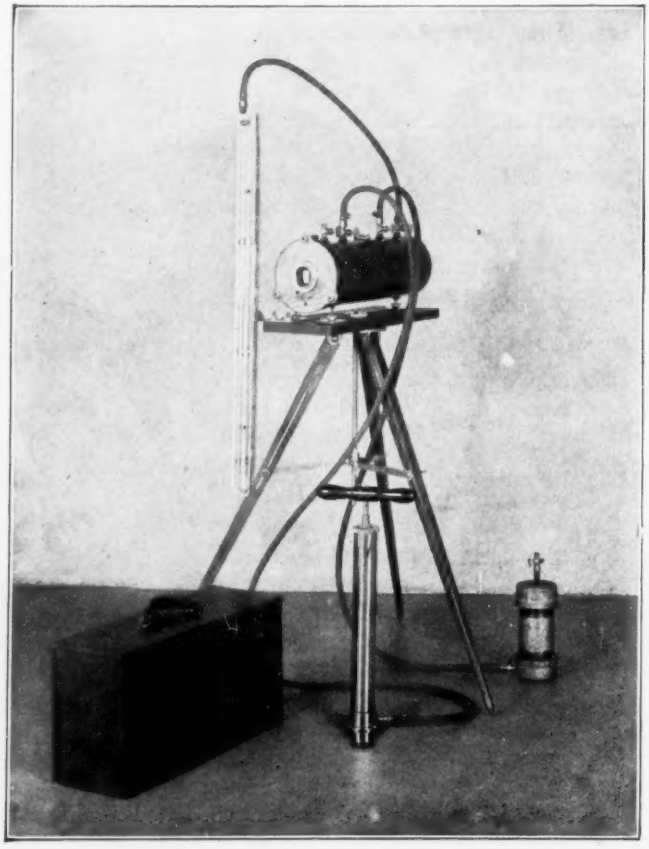
During the last year and a half, however, the mechanical difficulties have been overcome to the extent that there now exists a portable balance with laboratory exactness, and so ruggedly built that it may be easily carried to any point in the field where tests are to be made. It is easily and quickly put into operation by means of simple locking devices and when locked for portability is so rugged that severe jars will not affect it.

Tests conducted by the manufacturers in conjunction with many of the major companies of the Mid-Continent Field show conclusively that tests with the balance are much more accurate than bottle tests. Recently on a test using oxygen these machines operated in groups of four checked to within one point in the fourth decimal place of each other in continuous tests with different operators. On test after test, the balance unlike the bottle will check within a very few thousandths of a degree on every known gas, and will read to an extreme limit of accuracy on each test of the same quality of gas.

The principal of construction is comparatively simple. A balancing member consisting of a spun bulb filled with air on one end, and adjustable weights on the other is balanced on a suspension spring. By means of these weights the pressure of the air in the "float" is made to equal the normal days barometric pressure. The machine is then filled with

gas. When the gas is lighter than air the bulb or float will naturally sink. A manometer is attached to the top of the case and it is merely necessary to subject the gas in the machine to a slight pressure to bring the balancing mechanism back to zero on a scale in the machine.

The amount of pressure required to bring the machine back into a balance added to the barometric reading for the day is then divided into the day's barometric reading to obtain the specific gravity.



Operators checking gravity against each other in the field invariably check to a very small part of a degree with each other, eliminating the old guess work and mechanical inaccuracies of the bottle.

Tests of over a year, participated in by many large companies, have given extremely gratifying results and many have already entirely standardized on balance equipment with others who are rapidly following suit. Principal points of the balance have been covered for many years by several patents, which have been combined, but the ease of operation and decided mechanical improvements of the last year have made them practical and adaptable to the use of the gas industry.

# New Zeiss Projection Optimeter

*(George Scherr Co.)*

A PROJECTION Optimeter has recently been added to the Zeiss line of Optical Measuring Tools.

The standard optimeter (See Fig. 1) has been successfully used for checking slip, plug, snap and other gauges, measuring rods and discs. It has also been used for the highest class of selective assembling, measuring of balls and rollers for bearings, ball races, wires, spacing washers, etc. Fine wires, aluminum foil and the like may be readily measured without injury.

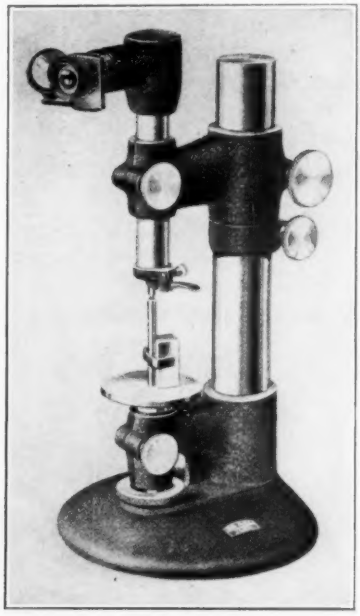


Fig. 1

The operating mechanism (See Fig. 2) comprises a mirror which is tilted by the action of a feeler point, and a graduation which with the aid of prisms and lenses is projected upon the mirror and reflected into the eye piece on an enlarged scale. The deviation of feeler point from the standard position is plainly indicated by a stationary scale, over which the image of the scale moves. Each space of the graduation is equivalent to 0.00005 inches, and quantities in the nature of 0.00001 inches may be readily estimated, as the space between two graduations appears to the eye as approximately 0.05 inches. The range of measurement is 0.0035 inches either side of zero.

The pressure used for the measuring action is very small (approximately ½ lb.). The deformation of fine work, such as tin or aluminum foil, thin wires, etc., is therefore nil. The pressure is kept uniform by the action of a small spring. The tilting action of the mirror is obtained by 3 balls, two being embedded in the bottom of the mirror, while the third is at the upper end of the feeler. The rolling action thus obtained will not alter the fulcrum distance as is the case where a wedge shaped fulcrum is used.

Compared with the standard Optimeter, the outstanding feature of the new instrument is visible reading of the scale by both eyes instead of by microscope. This has been accomplished by a change of the optical

tube, allowing a lamp holder as well as a screen attachment to be fitted to it (Fig. 3a.). Thereby the image of the scale as it is formed in the ocular is projected through a set of prisms onto the screen as shown in Fig. 3b.

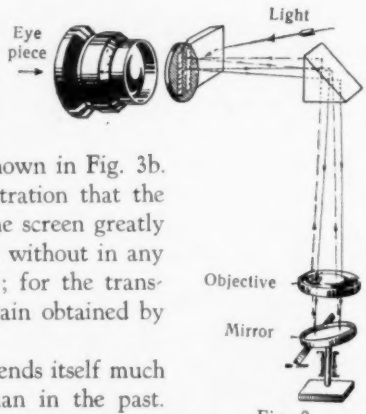


Fig. 2

It can be realized from this illustration that the reading of the measurement from the screen greatly facilitates the use of the instrument, without in any way impairing its extreme accuracy; for the transfer of the image to the screen is again obtained by purely optical means.

By visible reading the Optimeter lends itself much more readily to mass inspection than in the past. On the other hand the application of the Optimeter Tube to special fixtures is just as easy as ever, Tube and Projector being a self-contained unit.

Observation of the reading on screen is now available to two or more persons at the same time, which may be an important factor whenever disputes about differences in measurement have to be settled.

Other improvements embodied in the new design are a table with ser-

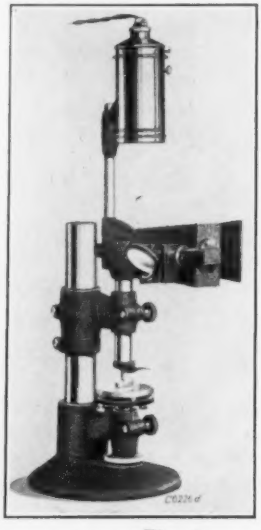


Fig. 3a

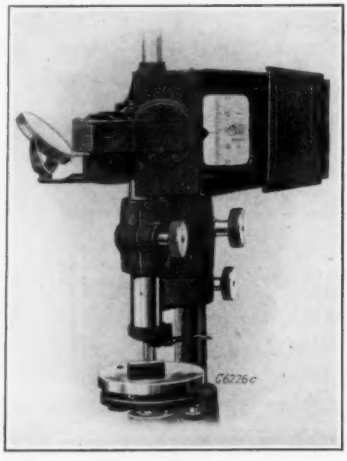


Fig. 3b

rated instead of solid surface, as well as an increased range of scale to plus and minus .005″; the graduation of the scale being .00005″ the same as in the standard optimeter.

The Projector is also available for the Horizontal and Inside Optimeter.

# Catalogue Library

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### Altimeter

"The Use of the 'Paulin System' Altimeters in Connection with Hydro-Electric and Irrigation Surveys" is the title of Bulletin No. 1 issued by The American Paulin System, Inc., 1220 Maple Ave., Los Angeles, Calif.

### Balancing Machine

The Tinius Olsen Testing Machine Company, 500 North 12 St., Philadelphia, Pa., have issued a leaflet on the Olsen-Lundgren Dynamic Balancing Machine.

### Bridges—Wheatstone and Kelvin

Circ. 4000a-G-50-1127, published by Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., illustrate the above bridges manufactured by them.

### Controls

Catalog No. "H"-3, 1928, of The Mercoid Corporation, 564 West Adams St., Chicago, Ill., describes and illustrates complete automatic controls for heating equipment.

### Come In!

Is the title of a recent direct mailing of The Bakelite Corporation, 247 Park Ave., New York, N. Y. It has a number of views of the research laboratory of this company.

### Controller for Mercerizing Baths

Circ. 40-G-15-128 of Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., briefly describes their Automatic Controller and Acid Valve for mercerizing baths.

### Duo-Stat

Bulletin No. 1 of F. I. Raymond Co., River Forest, Illinois, covers the automatic compensation of hot water heating systems for weather variations.

### Electrical Instruments

The Hoyt Electrical Instrument Works, 857 Boylston St., Boston, Mass., has available a folder containing a complete set of their literature on electrical instruments manufactured by them.

### Experimenter

The General Radio Experimenter for April contains articles on: "A Phonograph Amplifier" and "Parallel Plate Feed." This is issued monthly by the General Radio Co., Cambridge, Mass.

### Hydrogen Ion Control

"The A B C of Hydrogen Ion Control," Fourth Edition, recently issued by The La Motte Chemical Products Company, McCormick Bldg., Baltimore, Md., is a complete dissertation on this subject.

### Hydrogen Ion Indicator

Circ. 36-G-7-228, issued by the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., briefly describes the L & N Electrical pH Indicator for Process control in tanneries and water works.

### Intelligent Motoring

Is the title of a booklet explaining the application of the Tapley Gradient and Performance Meter in measuring and checking car performance. This booklet is issued by E. C. Cheswell, Melrose Highlands, 77, Mass.

### Kymographs

The Miller Kymographs are illustrated in Sup. 98-7½M-1 '28, issued by Arthur H. Thomas Co., West Washington Sq., Philadelphia, Pa.

### Liquid Meters

Bassler Liquid Meters for the accurate measurement of all petroleum products are described in a leaflet of the American Liquid Meter Co., 2217 Orange St., Alhambra, Calif.

### Measuring Tapes, Rules and Mechanical Tools

General Catalog No. Eleven of The Lufkin Rule Co., Saginaw, Mich., covers the complete line of products manufactured by them.

### Microscopes

The Spencer Lens Company, 19 Doat St., Buffalo, N. Y., has just issued M-31 covering the last word in their instruments.

### Microscope—Monobjective Binocular

Mikro 404 of Carl Zeiss, 485 Fifth Ave., New York, N. Y., describes their Monobjective binocular microscope Stand D.

### Micrometers

A leaflet, 40M-2-28, of Brown & Sharpe, Providence, R. I., illustrates three new micrometers which make measurements formerly requiring the use of twelve.

### Meters

The Yarnall-Waring Company, Chestnut Hill, Philadelphia, Pa., sent us a folder covering engineering devices for the power plant.

### Performance Meter

E. C. Cheswell, Melrose Highlands (77), Mass., has available a leaflet, "What Is the Pounds-Pull of Your Car?"

### Petroleum Calculator

The R. S. Fraser Petroleum Calculator is described in recent literature issued by The Refinery Supply Co., 4th & Detroit Sts., Tulsa, Okla.

### Pointer Draft Gage

A recent leaflet of Lewis M. Ellison, 214 W. Kinzie St., Chicago, Ill., describes and illustrates the Dial type pointer draft gage.

### Pointer Draft Gage

The Ellison Pointer Draft Gage with straight line movement is the subject of Bulletin ten of the Ellison Draft Gage Company, 214 West Kinzie St., Chicago, Ill.

### Pyrometers

Wilson-Maeulen Co., 383 Concord Ave., New York, N. Y., have issued a photolithographic copy of their regular catalog L. This tiny catalog is reduced to ¼ the area and ½ the length or width of the original.

### Radio Set Tester

The Weston A.C. and D.C. Radio Set Tester, Model 537, is illustrated in a recent leaflet of the Weston Electrical Instrument Corp., Waverly Park, Newark, N. J.

### Running Time Meter

The Hasler Tel Running-Time Meter registers accurately and automatically the elapsed operating time of machinery. It is briefly described in a recent leaflet of R. W. Cramer & Co., 136 Liberty St., New York. This instrument is of value to industrial engineers, production engineers, plant and maintenance engineers, accounting departments and experimental and testing laboratories.

### Recording Liquid Level Gauges

The Bristol Company, Waterbury, Conn., has just issued Catalog 1800 which describes and illustrates the Bristol Recording Liquid Level Gauge very completely. Methods of installing are shown, as well as a number of photographs of actual installations.

### Rubber Testing Machinery

Folder 237 of H. Z. Schniewind, 72 Duane St., New York, N. Y., illustrates the various Schopper testing machines for soft and hard rubber.

### Road Surface Rater

The Olsen-Andrew Road Surface Rater is briefly described in a leaflet issued by the Tinius-Olsen Testing Machine Co., 500 N. 12 St., Philadelphia, Pa.

### Recording Thermometers

No. 952 of the C. J. Tagliabue Mfg. Co., 18 Thirty-third St., Brooklyn, N. Y., describes the Tag Portable Recording Thermometers.

### Speed Indicator

The Weston Electric Speed Indicator is the subject of Bulletin 4400 issued by The Weston Electrical Instrument Corp., Newark, N. J. The construction of application of this instrument is covered in detail.

### Speed Recorders

"The Uses of Speed Recorders" is the title of Bulletin No. 328 just issued by The Esterline-Angus Co., Indianapolis, Ind.

### Surface Type Aquastat

The New Minneapolis Honeywell Surface Type Aquastat is briefly described and illustrated in FA-126-5M-3-28ZC issued by Minneapolis Honeywell Regulator Co., Wabash, Ind.

### Strain Finder

A report of a practical test on strain finder tested test tubes was recently issued by Arthur H. Thomas Co., West Washington Square, Philadelphia, Pa.

### Sugar Ash Bridge

Bulletin No. 497 of The Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., points out the need for sugar ash determinations. It covers also the theory of the electrical method and the operation of this instrument.

### Thermostats

Thermostats for industrial applications is the subject for a folder from Robertshaw Thermostat Company, Youngwood, Pa., illustrating the No. 3 high pressure thermostat for 1550 deg. F. regulation within 5 deg. F. in the heat treating department of Stewart Warner Speedometer Corporation.

### Time Controller

"Zeit-Kontroller" is the title of a recent leaflet issued by Dr. Rudolf Hase, Pyrowerk, Hanover, Germany. The instrument can be operated on any current and voltage. This leaflet is printed in German.

### Time Switches

R. W. Cramer & Company, Inc., 136 Liberty St., New York, N. Y., have available a folder on Sauter Electric Time Switches. The functions and applications of these switches is covered very thoroughly in the various bulletins contained in the folder.

### Telephone and Telegraph Testing

The Type T Testing Set is the subject of Circ. 5410a-G 65-1027 sent out by the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

### Testing Apparatus

The various testing apparatus built by Louis Schopper are illustrated in Folder No. 229 issued by H. Z. Schniewind, 72 Duane St., New York, N. Y.

### Temperature Controller

Bulletin No. G of the Thermo Instrument Company, 527 South High St., Akron, Ohio, describes and illustrates the temperature controllers manufactured by this company.

### Tensometer

The Huggenberger Tensometer is described in Tensometer Bulletin No. 1 issued by Southwork Foundry & Machine Co., 400 Washington Ave., Philadelphia, Pa.

### Theodolites

The new Fennel Standard Theodolites are covered in Catalog No. 126E issued by Otto Fennel Sons, Kassel, Germany. This bulletin is printed in English.

### Water Level Gauge

The McNeill remote liquid level gauge is illustrated and described in a recent leaflet of the Boiler Room Improvement Co., 4057 W. Van Buren St., Chicago, Ill.

### Water Works Journal

The April issue of this journal contains the following articles: Meeting Difficulties in the Royal Gorge; Water Works Improvements, Port Angeles, Wash.; Corrosion Resistant Metals; Water Works Advertising and Advertising and the Endorsement Bunk. This paper is issued by the Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa.

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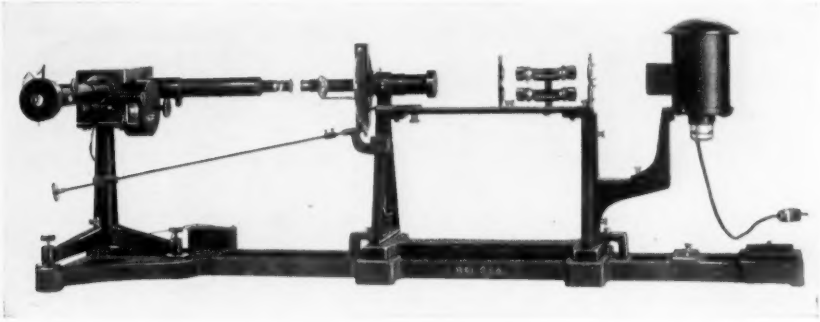
# BAUSCH & LOMB
## OPTICAL COMPANY



## The *NEW* Spectrophotometric Outfit

THIS new spectrophotometric outfit consists of three major units, each of which is designed to give the highest degree of efficiency and accuracy.

The photometer, which is of the polarization type provides an excellent white light photometer for use in photography and densitometry. It is aptly designed for comparison of lights and measurement of transmission and absorption curves of liquids and solids.

The spectrometer is of the constant deviation type. The prism is mounted within a dustproof housing on a rotating table actuated by a drum on which the wavelength scale is engraved. Rotation brings the desired portions of the spectrum upon the central part of the field.

The photometric stand permits an excellent fixed source of illumination which serves both fields of the photometer, making them independent of variations and intensity.

An investigation of this outfit will amply repay you.

Price of outfit as described above, less specimen tubes,

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# Current Literature Review

**Abstracts on instruments of interest to instrument readers**

**Thermo-Wattmeter for Small Power Factor and High Frequency.** (Thermo-Wattmeter fuer geringen Leistungsfactor und fuer Hochfrequenz.) E. Kuhnel. Zs. Instrument. March 1928, pp. 127-130.

The Weston and Kipp Wattmeters are described.

**Improvement of the Recording Pen.** (Verbesserung der Registrierfeder.) W. Keil. Zs. Intrument. March 1928, pp. 130-131.

An improved pen is described and illustrated.

**Arrangement for the Extension of Star Spectra for Photometric Purposes.** (Vorrichtung zur Verbreiterung von Sternspektren fuer photometrische zwecke.) B. Meyermann. Zs. Instrument. March 1928, pp. 104-105.

An apparatus for this purpose is briefly described and illustrated.

**Precision Determination of Frequency.** J. H. Horton and W. A. Morrison. Proc. Inst. Radio Engrs. Feb. 1928, pp. 137-154.

The relations between frequency and time are such that it is desirable to refer them to a common standard. Reference standards, both of time and of frequency, are characterized by the requirement that their rates shall be so constant that the total number of variations executed in a time of known duration may be taken as a measure of the rate over shorter intervals of time. Frequency standards have the further requirement that the form of their variations and the order of magnitude of their rates shall be suitable for comparison with the waves used in electrical communication.

Two different types of standard which meet these requirements are described. One consists of a regenerative vacuum tube circuit, the frequency of which is determined by the mechanical properties of a tuning fork. The other is a regenerative circuit controlled by a piezo-active crystal. Means are provided, in each case, whereby the recurrent cycles may be counted by a mechanism having the form of a clock, the rate of which is a measure of the frequency of the reference standard.

Data taken over a period of several years with a fork controlled circuit show that under normal conditions, its rate may be relied upon to two parts in a million. Data taken over a much shorter time with crystal controlled oscillators indicate that they are about 10 times as stable.

**Measurement of the Thickness of Involute Gear Teeth.** Allan H. Candee. Amer. Mach. March 15, 1928, pp. 463-467.

Calculations for pin measurement of gear teeth with standard pin sizes. Simplification of the calculations by means of standard tables for both external and internal gears.—H. S.

**Freeing Production from Traditional Handicaps.** Amer. Mach. March 15, 1928, pp. 441-443.

Technical research and laboratory control of critical processes of the International Silver Company, relieves production from many of the mishaps that have heretofore been accepted as unavoidable.

**Demonstrations with a Lamp-Room Photometer.** J. S. Haldane and R. V. Wheeler. Trans. I.M.E. Feb. 1928, pp. 308-310.

The shadow principle was used in the lamp-room photometer with which the demonstration was made. This instrument is briefly described.

**Methods for Silvering Mirrors.** (Ueber die Versilberung optischer Instrumente.) Gl. Ind. Jan. 1928, pp. 6-7.

Formulae are given.

**Thermal Volume Meter.** G. W. Penney and C. J. Fechheimer. Jl. A.I.E.E. March 1928, pp. 181-184.

Abridgement of a paper given before the Winter Convention of the A.I.E.E. in New York. The paper discusses the "Thomas Meter," the principle of which is that a gas is heated by means of an electric heater, the change in temperature being accurately measured either by means of resistance thermometers connected in a wheatstone bridge network, or by means of a thermopile. The paper deals mostly with the latter method.

The possible sources of error in the meter are discussed.

**The Effect of Temperature on Gas Measurement.** Alexander B. Morris. Nat. Gas. Feb. 1928, pp. 22-23, 57.

The results show that there is considerable variation in the volume of gas metered as well as the quantity of gasoline yielded at different temperature conditions.

**Temperature and Humidity Control in Rooms for Concrete Study.** Engg. News-Rec. March 8, 1928, pp. 395-396.

Automatic devices keep heat and moisture constant while test specimens age in University of California Laboratory.—J. H.

**Calorimetric pH Determinations in a Neutral Atmosphere.** Henry F. Muer and Frank E. Hale. Jl. Amer. Waterw. Ass. Feb. 1928, pp. 201-206.

Comparison is made of the results of calorimetric pH determination obtained by three methods.

**The Use of the Wind Channel for Performance Prediction.** R. K. Pierson. Jl. Royal Aero. Soc. Feb. 1928, pp. 96-126.

Description of model. Wind channel and method of support. Propellor driving apparatus. Method of test. Corrections to measurements. Scale effect correction. Shipstream effect. Modification of design. Accuracy of prediction. Discussion.

**An Electrical Solution Mixing Device.** K. Hickman and D. Hyndman. Jl. Soc. Chem. Ind. Feb. 1928, pp. 238-241.

A device developed at the Eastman Kodak Research Laboratories is described.

**Inspection Devices in the Westinghouse Plant.** William H. Miller. Machinery. March 1928, pp. 501-503.

Two adjustable beam-type gages. Spherical and depth gages for bearings. Testing device for extension springs. Fixture for checking various drilling, boring and milling operations. Checking squareness of commutator bars. Device for checking flat springs.

**A Modified Thermoregulator.** Alexander Lehrman. Ind. Engg. Chem. March 1928, p. 290.

A wiring diagram showing modifications is given. Constancy to 0.02 degrees can be maintained.—M. E. H.

**The Determination of Sulphur and Hydrogen Sulphide in Gases Distilled from Coal.** (Die Bestimmung des Schwefels und Schwefelwasserstoffs in Kohlendestillationsgasen.) R. Kattwinkel. Messtechnik. Feb. 22, 1928, pp. 29-33.

Quantity and distribution of sulphur compounds in the gases distilled from coal. Methods of determining the total sulphur in gas. Experimental testing of the Dickert method. Methods for determining the hydrogen sulphide. Titration arrangement for the quick determination of hydrogen sulphide.—Ha.

**The Investigation of Sides of Bored Holes.** (Die Untersuchung von Bohrungswandungen.) O. Nieberding. Messtechnik. Feb. 22, 1928, pp. 33-36.

Significance of optical examination of the inner walls of bored holes, tubes, and hollow bodies. Microscope for bored holes. Tube observation telescope for motor cylinders. Telescope for long pipes, tubes, waterpipes, etc.—Ha.

**A New Hardness Testing Accessory.** (Ein neues Haertepruefgeraet.) M. Moser. Messtechnik. Feb. 22, 1928, pp. 37-39.

An arrangement for measuring the diameter of impression of the Brinell ball under load as the cutting line of its own shadow and the one cast by it. Schematic representation of the method. The practical advantages of the objective method. Use of the arrangement with the Wilk automatic testing machine. Description given.—Ha.

**Practical Pyrometry.** J. R. Collins. Fuels & Fces. March 1928, pp. 301-308.

Determination of standard temperature scale. Choice of an instrument. Various kinds of pyrometers, their theory, application and uses.—M. B. R.

**Temperature Control in the Enameling Furnace.** J. E. Hansen. Fuels & Fces. March 1928, pp. 327-328, 350.

The effect of the time-temperature comeback of the enameling furnace. Multiple deck burning aids toward obtaining a slower comeback and increased production.

**Spring Heat Treating Furnaces Automatically Controlled.** Frank Stones. Fuels & Fces. March 1928, pp. 373-376.

Automobile spring heat treating unit consists of hardening and tempering furnaces which are fired with oil and have temperatures automatically controlled.—M. B. R.

**The Importance of Furnace Control for Heat Treatment of Non-Ferrous Metals.** James Silberstein. Fuels & Fces. March 1928, pp. 333-334.

Annealing takes place over wide temperature range but properties other than hardness are seriously affected if accurate furnace temperatures are not obtained. Hardening to obtain increased strength requires close temperature regulation.—M. B. R.

**Pyrometric Regulation of Heat Treating Operations.** William P. Wood. Fuels & Fces. March 1928, pp. 347-350.

A discussion of hat treatment emphasizing the importance of obtaining correct furnace temperatures to secure the desired metallurgical properties.—M. B. R.

**The Effect of Heat Treatment on the Physical Properties of Glass.** A. Tool and D. Lloyd. Fuels & Fces. March 1928, pp. 353-356, 364.

Attainment of exact and uniform temperatures essential in obtaining desired physical properties in glass.—M. B. R.

**Temperature Control in Japanning Ovens.** W. J. Miskella. Fuels & Fces. March 1928, pp. 361-364.

Accurate temperature control necessary to produce good products; various means of controlling temperatures. Their construction and method of installation.—M. B. R.

**Generator for Audio Currents of Adjustable Frequency with Piezo-Electric Stabilization.** August Hund. S 569, Sc. Papers B. of S.

# Readers' Comments

Dear Sir:

I like INSTRUMENTS. I am pleased with the idea of a publication devoted to the exposition of instruments in their relation to life. And I am impressed by the array of talent displayed in the tabulated list of your collaborators. In short, I am deeply gratified to feel that in INSTRUMENTS I have an unbiased exponent of the part instruments play—and have played—in the march of science.

The Galileo sketch in your April issue is bad history. And, while it were tiresome to enumerate and again refute all the misstatements and false implications in this short biography, notice of the more striking ones will serve to substantiate the above charge.

I quote from INSTRUMENTS, p. 173: ". . . provided always that nothing could be proved against the supposed assertion of the Bible that the earth did not move . . ."

This passage is historically false, and by itself sounds the keynote of the complete sketch.

It was Nicholas of Cusa (born 1401), who, in his work *De Docta Ignorantia*, called attention to the theory of the earth's motion. A bold statement which did not prevent his elevation to the Cardinalate, nor did it win him censure from Pope or Roman Congregation.

It is a matter of common knowledge that Copernicus, the man to whom the honor for the initial statement of the heliocentric theory is properly assigned, was appointed official astronomer in Rome, under the immediate patronage of the Pope, and there lectured in astronomy to the end of his life. His theory went unmolested for something over twenty-five years before Galileo made his telescopic observations. The theory was discussed much by philosophers in these years—and discussed scientifically, that is, as a theory.

Copernicus, by the way, in publishing the exposition of his theory (De Orbium Coelestium Revolutionibus) did so at the earnest solicitation of his friends, Cardinal Schomberg and Tiedmann Giese, Bishop of Kulm. And he dedicated the work to Pope Paul III. Cardinal Barberini, afterwards Pope Urban VIII (mentioned on p. 173 of INSTRUMENTS most ambiguously) defended the theory in a discussion in the palace of the Duke of Tuscany and afterwards patronized it at Rome.

On the other hand, Luther and Melancthon denounced Nicholas Copernicus in unmeasured terms for his theory—Tycho Brahe would not accept it—Lord Bacon refused to admit it—Kepler was persecuted by his Protestant brethren for defending it (but he was received into the Catholic college of Grätz, and was offered a chair in the University of Padua by Catholic Venice).

This was the status of the Copernican Theory in Galileo's time.

Galileo did not have to "extort" recognition from the "authorities" (INSTRUMENTS, p. 171) for his talents. This is a distorted statement. Recognition of his really substantial contributions to science was fully and freely given by all—clerical and lay—competent to judge in such matters.

In the field of mechanics—particularly dynamics (which science may be said to owe its existence to him)—he attained conspicuous success and acclaim. Among his contributions to human knowledge it is proper to mention that he established the laws of falling bodies as they are still formulated; that he demonstrated the laws of projectiles; and that he, to a degree, anticipated the laws of motion as finally established by Newton (and now questioned by Einstein). Further, it was his treatise on the center of gravity of solids which won him the title of the Archimedes of his time; it also gained for him the lectureship in the University of Pisa.

Oddly enough INSTRUMENTS omitted mention of the astronomical clock devised by Galileo as a direct result of his discovery of the isochronism of the pendulum in the Cathedral of Pisa.

On page 173 of INSTRUMENTS, the last two paragraphs are badly garbled. From these one gathers that Galileo was a man striving vainly to make obdurate churchmen accept a proven fact of science. Nothing could be farther from the truth. For Galileo never proved the heliocentric theory (it was not proved until long after the death of Galileo). But failure to prove it did not deter him from proclaiming and teaching the theory as fact; nor did it deter him from entering the realm of exegetics—a science for which he was ill-fitted indeed—on the mere strength of his dictum. This example of pseudo-scientific sophistry is equaled only by that of our modern "scientists" who vehemently proclaim the Fact—not the Theory—of Evolution.

For his obstinacy in this matter Galileo was reproved; for this was his teaching condemned. And rightly so. Indeed, the comment of Prof. Huxley was that the Pope and Cardinals had rather the best of the controversy.

Galileo was particularly unfortunate in his appeal to the flux and reflux of the tides to support the heliocentric theory. He scored Kepler's suggestion that tidal phenomena might be due to lunar action. And this suggestion was, of course, in line with the truth.

As for Galileo being ". . . summoned to Rome to answer the charge of heresy . . ." (p. 174), please note the following extract from The Catholic Church and its Reactions with Science, pp. 108-9, by Sir Bertram C. A. Windle, M. A., M. D., Sc. D., Ph. D., LL. D., F. R. S. pub. by The MacMillan Co.

". . . take the following quotations from Whewell, a Protestant, as are all the authorities he quotes:

> 'Liebnitz, Guizot, Spittler, Eichorn, Raumer, Ranke and almost all the persons who have studied the facts have at least done justice to the Church; that Galileo trifled with authority to which he professed to submit and was punished for obstinate contumacy and not for heresy. This celebrated event must be looked upon rather as a question of decorum than a struggle in which the interests of truth and free enquiry were deeply concerned.' "

The whole third paragraph on page 174 is a gem of inconsistency, misstatement, and misrepresentation. It is here we learn that although Galileo ". . . was treated with great leniency . . ." he ". . . confessed his 'error' . . ." because he was in ". . . fear of torture . . ." All of which is quite absurd. He feared no torture; the event proved this.

Again, the last paragraph of page 174 informs the reader that Galileo was directed ". . . to remain in his own house in perpetual solitude. . ." 'Tis an odd solitude one suffers in which he is in constant communication with his family and friends. Such was Galileo's solitude.

And may I suggest that the account of his demise would have been quite as touching and not so misleading if mention had been made of such modifying circumstances as that he received the Papal benediction in extremis from Urban VIII, together with all the Sacraments proper to a Catholic preparation for death; and that his body was buried in his own parish church of Santa Croce in Florence?

The writer feels that it would be to the point to state authority for matter such as the biography under consideration. This was done in your sketch of Volta—why not in that of Galileo? Your readers are entitled to know the sources you consult in publishing such things.

In view of the foregoing the writer expects you to make adequate amends for the Galileo sketch in an early issue. For while he feels that INSTRUMENTS acted in good faith in publishing this sketch for publication, he must insist that amendments and corrections be given the same publicity as the original.

Very truly yours,

J. B. KELLER,
Wilson, Penna.

April 23, 1928.

A heat-frequency generator is described for producing audio currents which are practically sumdoidal. The frequency is adjustable and stabilized by means of a piezo-electric gravity disk and can be read directly from a scale. The holder containing the piezo-electric element has a band control for changing the frequency of the gravity disk by a small amount.

For very accurate work a thermostatic control is provided. A specially designed power amplifier also is described, which can be used when more energy is required.—L. E. B.

**Thermal Expansion of Alloys of the "Stainless Iron" Type.** Peter Hidnert and W. T. Sweeney. S 570, Sc. Papers B. of S.

This paper gives the results of experiments made by the use of apparatus which is fully described in Bureau of Standards, Scientific Paper 524. Results are given on the linear expansion of nine samples of stainless iron with chromium content varying from 11.9 to 16.4%, and carbon content from 0.09 to 0.13%. These determinations were made over various temperature ranges between room temperature and 1000°C. Transformation regions were located on some of the samples. The expansion curves of all samples are shown and discussed.

The data relation to the critical regions indicate that an increase in the chromium content generally causes a slight increase in the temperature at which the transformation on heating decreases with increase in the chromium content.—L. E. B.

**Thermal Expansion of Beryllium and Aluminum-Beryllium Alloys.** Peter Hidnert and W. T. Sweeney. S 565, Sc. Papers B. of S.

Results on the linear expansion of beryllium (98.9%) and five aluminum-beryllium alloys containing from 4 to 33% beryllium are given. The expansion curves of the metal and alloys are shown and discussed.

The coefficient of expansion of aluminum-beryllium alloys decrease with increase in the beryllium content. On a second heating the coefficients are generally larger than corresponding values obtained in the first heating.—L. E. B.

**Absolute Measurements of Capacitance by Maxwell's Method.** Harvey L. Curtis and Charles Moon. S 564, Sc. Papers B. of S.

The absolute measurement of capacitance by Maxwell's method is based on the assumption that certain conditions are fulfilled by the experimental apparatus. The most important of these conditions is that the galvanometer correctly integrates the current.

The method requires that a condenser be charged and discharged at a known rate. To accomplish this, contacts of platinum dipping in mercury cups are placed on the prongs of a tuning fork driven by an electron tube. This permits of balancing the Maxwell bridge with the same ease and accuracy as a Wheatstone bridge. Results are given showing the accuracy that can be obtained.—L. E. B.

**Density of Hot Rolled and Heat Treated Carbon Steels.** H. C. Cross and E. E. Hill. S 562, Sc. Papers B. of S.

In this report are given density values for commercially pure and electrolytic irons and a series of carbon steels with carbon content varying from 0.09 to 1.29%. Density values are given for these steels when hot-rolled, when annealed, when quenched and tempered. The steels were quenched in water, and were then tempered at successively higher temperatures up to 600°C. and density determinations made after each treatment.—L. E. B.

**A Burette for the Accurate Measurement of Gas Volumes with Gas Connections to a Compensator.** E. R. Weaver and Martin Shepherd. S 559, Sc. Papers B. of S.

This paper describes a burette, for measuring gas volumes, which embodies a novel compensator designed to eliminate errors of diffusion into the manometer. The burette is approximately 38 cm. in length with a total capacity of 125 cc. An accuracy of 0.01 cc. is readily obtained.—L. E. B.

**Electrolysis Testing.** Burton McCollum and K. H. Logan. T 355, T. P. B. of S.

Various electrolysis tests are discussed in the light of the most recent data concerning them. The older methods of determining general electrolysis conditions are first discussed and then a detailed description of the new apparatus and methods is given. This is followed by a description of tests for the determination of track conditions and a discussion of the interpretation of electrolysis data.—L. E. B.

**Calibration and Adjustment of the Schopper Folding Tester.** F. T. Carson and L. W. Snyder. T 357, T. P. B. of S.

The Schopper folding tester is so constructed that a number of mechanical variables are introduced by reason of the several rollers and other working parts which are driven by the piece being tested. These mechanical variables can in general be expressed as quivalent effective tensions.

A new device is described in this paper, which permits calibration and adjustment of the springs without disturbing the assembly of the tester. A method also is outlined for measuring the friction of the rollers.—L. E. B.

**Field Balancing Rotors at Operating Speed.** G. B. Karelitz. Power. Feb. 2, 1928 pp. 237-240.

The forces acting to cause vibration are analyzed. The Vibrometer, an instrument for measuring vibration is described.

**Speed Measurements Should be Accurate.** Power Pl. Engg. Feb. 1, 1928, pp. 194-195.

The types of speed or revolution counters are illustrated and briefly discussed.

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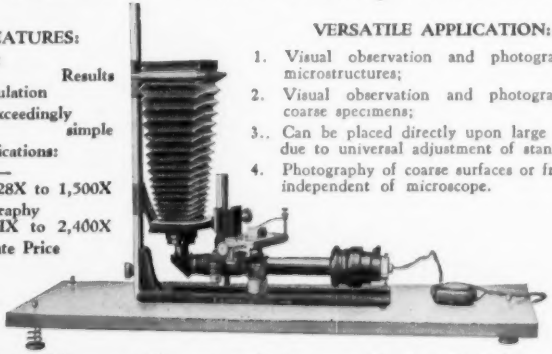

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**The Importance of Volumetric Stress Conditions for Material Testing.** (Die Bedentung raeumlicher Spannungszustaende fuer die Workstoffpruefung). P. Ludwik. Ber. Fachaussch. Werkstoffausschuses No. 121. Feb. 1928.

Volumetric stress relations with compressive and tensile tests, with heat, cooling and straightening stresses. Comparative tensile and torsion tests. Notch effects with static, dynamic and alternating stresses. Elastic limit, fatigue limit.

**Year's Experience with a Demand Rate for Gas Househeating.** H. C. Deffenbaugh. Amer. Gas. Jl. Feb. 1928, pp. 38-41.

Securing a low rate. Demand Meter eliminates errors. Average rate. Load factor of different types of heating systems.—M. B. R.

**Measuring Destructive Earth Currents.** Burton McCollum and K. H. Logan. Amer. Gas Jl. Feb. 1928, pp. 44-46.

Abstract of Bureau of Standards, Technologic Paper 351 entitled "Practical Applications of the Earth-Current Meter." Function of earth-current meter. Description and use of apparatus. Influence of rails and pipes.—M. B. R.

**Machinery Tests the Telephone.** Amer. Mach. March 8, 1928, pp. 419-420.

Illustrations of machines used in the testing of telephone parts and materials.—H. S.

**Optical Instrument Demands Unusual Precision.** Henry Simon. Amer. Mach. March 8, 1928, pp. 421-423.

The scribing and checking of a half-inch line on a blade, used in a Zeiss measuring microscope, is described. An accuracy within plus or minus 0.00002 in. must be maintained.—H. S.

**The Measurement of Acoustic Impedance and the Absorption Coefficient of Porous Materials.** E. C. Wente and E. H. Bedell. Bell Jl. Jan. 1928, pp. 1-10.

Various ways of determining the acoustic impedence and the absorption coefficient of porous materials from measurements on the standing waves in tubes are discussed. In all cases the material under investigation is placed at one end of the tube and the sound is introduced at the other end. Values of the coefficient of absorption of a number of commonly used damping materials as obtained by one of the methods are given. Several types of built-up structures are shown to have a greater absorption coefficient for low frequency sound waves than is conveniently obtainable by a single layer of material.—L.

**Electrical Measurement of Communication Apparatus.** W. J. Shackelton and J. G. Ferguson. Bell Jl. Jan. 1928, pp. 70-89.

Paper describes precision high-frequency measurements of a fundamental type, special emphasis being placed on the measuring circuits rather than on the types of apparatus measured. Standards of frequency resistance, capacitance, and inductance are discussed briefly. Bridge measurements are described for the measurement of frequency, inductance, effective resistance, capacitance, dielectric loss, capacitance balance and inductance balance. Circuits for the measurement of other high-frequency charactristics, such as attenation, gain and cross-talk are included.L.

**A New Gas-Measuring Miner's Electric Lamp.** W. M. Thornton. Coll. Guard. Feb. 24, 1928, pp. 729-730.

A lamp for the detection of methane is described. Abstract of paper before the North of England Institute of Mining and Mechanical Engineers.—C.

**Electrical Insulating Oil** (Concl.). Dean Harvey. Elec. Jl. March 1928, pp. 127-130.

Method of test for dielectric strength. Purification. Comparison of purifying processes.—Ha.

**A New Resistor for Use in Measurements of Impulse Voltages and Currents.** Edward Beck. Elect. Jl. March 1928, pp. 157-158.

Describes Zircon resistor for use as shunt for measuring current by means of sphere gaps, klydonographs or oscillographs; and as potentiometers for measuring voltage.—Ha.

**Automatic Boiler Plant Control.** David Brownlie. Engg. Boiler House Rev. Feb. 1928, pp. 370-372.

Early Efforts. General Principles. Experience in Great Britain. Present tendencies.

**The Use of the Bomb for the Determination of Carbon and Hydrogen.** J. W. Whitaker. Fuel Sc. Pr.

Describes the method of determining carbon and hydrogen by the use of the Goutal bomb.—C.

**Some Screw Propeller Experiments with Particular Reference to Pumps and Blowers.** Henry F. Schmidt. Jl. Amer. Soc. Naval Engrs. Feb. 1928, pp. 1-26.

Describes a series of tests made with a number of different propellers.

**The Determination of Iron in Glass Sand.** G. E. F. Lundell and H. B. Knowles. Jl. Amer. Ceram. Soc. March 1928, pp. 119-125.

Data are presented in tabular form showing the determination of iron in the Bureau of Standards Sample of Glass Sand, No. 81. The electrometric titration method, the $H_2S$ reduction method, and the gravimetric method are described in detail.—M. E. H.

**The Use of Indicators in the Calorimetric Determination of Hydrogen Ion Concentration.** T. H. Fairbrother. Ind. Chem. Feb. 1928, pp. 66-69.

Theories of indicator color changes. Choice of suitable indicators. Continued in March issue.—M. E. H.

**A New Gas Measuring Miner's Electric Lamp.** W. M. Thornton. Ir. Coal Tr. Rev. Feb. 24, 1928, p. 258.

A lamp for the detection of methane is described. Abstract of a paper before the North of England Institute of Mining and Mechanical Engineers.—C.

**The Neon-electric Stroboscope.** E. E. Steinert. G. E. Rev. March 1928, pp. 136-139.

Development. General. Types of Stroboscopes. Neon-electric Stroboscopes. Disk.—Ha.

**Apparatus Standards of Telephonic Transmission, and the Technique of Testing Microphones and Receivers.** B. S. Cohen. Jl. Inst. Elec. Engrs. Feb. 1928, pp. 165-203.

The first part of the paper deals with the selection, calibration, maintenance and operation of apparatus standards selected as representative samples of the types of telephones in general use. Particulars of the acoustical and electrical characteristics of microphones and receivers are given.

The second part of the paper deals with telephone standards giving high quality transmission and specially designed for standardization purposes, and of which the acoustical and electrical characteristics are capable of precise specification and measurement.

The appendix deals with the range of frequencies required for various classes of telephonic transmission.—Ha.

**Viscosity of Lubricants Under Pressure.** Mayo D. Hersey and Henry Shore. Mech. Engg. March 1928, pp. 221-232.

An experimental determination of the combined effects of high pressures and temperatures, using ball-and-slanted tube type Viscometer.

The five oils selected for the investigation are typical of the better-known classes of animal, vegetable, parafin-base, naphthene-base, and blended oils. The maximum pressures and temperatures reached were respectively about 4000 kg. per sq. cm. and 140°C. Lard oil solidifies abruptly on passing through a critical pressure which at 22°C. is about equal to 1550 kg. per sq. cm. The parafin-base oil shows a somewhat similar effect. For all oils tested except, notably, lard oil it was found that the temperature coefficient of viscosity is considerably increased under moderately high pressures.

**General Application of Photography to Mechanical Engineering.** Mech. Engg. March 1928, pp. 198-204.

Its use in optical stress determination, recording invisible radiation and practically instantaneous occurances. Study of explosions. Ground and aerial surveying. Studying of rapidly moving objects by means of retarded motion pictures.

**Photomicrography and its Application to Mechanical Engineering.** Francis F. Lucas. Mech. Engg. March 1928, pp. 205-212.

Description of equipment of Bell Telephone Laboratories for technical microscopy, together with particulars regarding the application of high-power metallography to the study of structures found in hardened steel.

**X-Ray Examination of Structural Materials.** Wheeler P. Davey. Mech. Engg. March 1928, pp. 213-216.

Its value in the solution of factory problems, and in the search for new scientific principles which may explain known facts or be applied to the development of new materials.

**Kinematographic Studies in Aerodynamics.** Alexander Klemin. Mech. Engg. March 1928, pp. 217-220.

Early experiments in momentary photography. Early experiments in kinematography. High-speed kinematography. An instrument of value. Particulars regarding high-speed motion picture methods at the Tokyo Aeronautical Research Institute.

**Boiler Instruments in the Small Plant.** Russell Stockheker. So. Power Jl. March 1928, pp. 58-61.

Advisability of instruments in the small power plant pointed out. Practical recommendations of a studied method of progressive purchase of instruments in accordance with the importance of their need is given.

**Testing and Care of Venturi Meters.** Fred Emmar. Power Pl. Engg. March 1, 1928, pp. 286-288.

Part I gives instructions and systematic procedure for checking meters and keeping them in condition to give accurate readings.

**The Dufour Cathode Ray Oscillograph.** I. E. Cole. Bell Labs. Rec. Jan. 1928, pp. 141-144.

The construction principle of the instrument is given.—Ha.

**New Rubber Compression Testing Machine.** C. L. Hippensteel. Bell Labs. Rec. Jan. 1928, pp. 153-155.

A new machine is briefly described here.—Ha.

**The 5-A Audiometer.** L. G. Hoyt. Bell Labs. Rec. Jan. 1928, pp. 159-162.

The principle of the use of this instrument for making hearing sensitivity is discussed and the instrument described and illustrated.—Ha.

**The Laws of Error of Length Measurements.** (Die Fehlergesetze der Laengenmessung.) Prof Klasmer. Zs. Vermess. March 1, 1928, pp. 129-140.

Optical distance measurement and their laws of error.—J. H.

# Review of Recent Patents

**Printed copies may be obtained at the cost of 10 cents by addressing the Commissioner of Patents, Washington, D. C.**

**GROUND SPEED METER.** Samuel Herbert Anderson, Seattle, Wash. Pat. No. 1,664,395.

**COMBINED STATOSCOPE AND RATE OF CLIMB INDICATOR.** Franklin L. Hunt and Atherton H. Mears, Washington, D. C. Pat. No. 1,664,417.

**AIRCRAFT GROUND-SPEED INDICATOR.** Franklin L. Hunt and Roy C. Sylvander, Washington, D. C. Pat. No. 1,664,454.

**THERMOSTAT CONTROL FOR COOKING UTENSILS.** John Hays Hammond, Jr., Gloucester, Mass. Pat. No. 1,664,551.

**INDUCTION ELECTRICITY METER.** Albert L. Ewens, La Fayette, Ind., assignor to Duncan Electric Mfg. Co. Pat. No. 1,664,672.

**INDUCTION ELECTRICITY METER.** Albert L. Ewens, La Fayette, Ind., assignor to Duncan Electric Mfg. Co. Pat. No. 1,664,673.

**METHOD FOR MEASURING THE DENSITY OF GAS.** George Konig, Berlin-Dahlem, Germany. Pat. No. 1,664,752.

**NONVIBRATING GAUGE.** Otto W. Heise, Bridgeport, Conn., assignor by mesne assignment to Consolidated Ashcroft Hancock Co. Pat. No. 1,664,776.

**THERMOSTAT.** Lee P. Hynes, Albany, N. Y., assignor by mesne assignment to Consolidated Car-Heating Co. Pat. No. 1,664,778.

**SIZE INDICATOR FOR SURFACE GRINDING.** Carroll Knowles, Hartford, Conn., assignor to Pratt & Whitney. Pat. No. 1,664,823.

**MICROMETER CALIPER.** Harry C. Schaper, St. Louis, Mo. Pat. No. 1,664,833.

**THERMOSTATIC CURRENT CONTROL.** Otto Q. Beckworth, Los Angeles, Calif. Pat. No. 1,665,014.

**FLOW METER.** Charles Peter Mayer, Elizabeth, N. J. Pat. No. 1,665,141.

**THERMOSTATIC BRAKE.** Frederick N. Connet, Providence, R. I., assignor to Builders Iron Fdry. Pat. No. 1,665,201.

**OPTICAL SPEEDOMETER.** George Ramsey, Brooklyn, N. Y. Pat. No. 1,665,278.

**ELECTROMAGNETIC DEVICE.** Edward D. Mead, Caldwell, N. J., assignor to Western Electric Co. Pat. No. 1,665,318.

**TEMPERATURE-COMPENSATING SPRING.** Joshua Patrick, Detroit, Mich. Pat. No. 1,665,322.

**THERMOSTAT.** Vitus A. Boker, Minneapolis, Minn. Pat. No. 1,665,341.

**ELECTRICAL MEASURING APPARATUS.** Felix Wunsch, Philadelphia, Pa., assignor to Leeds & Northrup Co. Pat. No. 1,665,397.

**LIQUID-LEVEL INDICATOR.** Frederick A. Carmona and Alfred M. Sands, Berkeley, Calif., assignors to Carmona-Sands Corp. Pat. No. 1,665,530.

**THERMOSTAT.** Louis W. Schnepp, San Bernardino, Calif. Pat. No. 1,665,719.

**GLISSOMETER.** Clarence J. Rodman, Wilkinsburg, Pa., assignor to Westinghouse Electric & Mfg. Co. Pat. No. 1,665,933.

**INDICATOR FOR AUTOMATIC SLOWNESS TESTERS.** Milton O. Schub, Berlin, N. H., assignor to Brown Company. Pat. No. 1,666,034.

**METER.** Wholston Vanderbilt Stockton, Jr., Albany, N. Y., assignor to American Meter Company, Inc. Pat. No. 1,666,075.

**PRECISION ALTIMETER.** Dache M. Reeves, Lee Hall, Va. Pat. No. 1,666,179.

**THERMOSTAT.** John E. Bolling, Chicago, Ill., assignor to Drying System, Inc. Pat. No. 1,666,192.

**ELECTRIC TESTER.** Arthur L. Smith, Portland, Ore. Pat. No. 1,666,273.

**MAGNOMETER.** John N. Ray, Newark, N. J., assignor by mesne assignments to Brandes Laboratories, Inc. Pat. No. 1,666,309.

**GAUGE.** Austin O. Cravin, Chicago, Ill. Pat. No. 1,666,556.

**McLEOD-TYPE PRESSURE GAUGE.** Carl S. Hornberger, Chicago, Ill., assignor to Central Scientific Company. Pat. No. 1,666,739.

**McLEOD-TYPE PRESSURE GAUGE.** Paul E. Klopsteg, Chicago, Ill., assignor to Central Scientific Co. Pat. No. 1,666,743.

**PNEUMATIC PRESSURE GAUGE.** Andre Jules Michelin, Paris, France, assignor to Michelin et Cie, France. Pat. No. 1,666,787.

**FLOW REGULATOR FOR OIL BURNERS.** Jackson G. Gilmore and Augustus J. Frame, Columbus, Ohio. Pat. No. 1,667,314.

**TESTING METHOD AND APPARATUS.** Frederick W. Stockmeyer, Cincinnati, Ohio. Pat. No. 1,667,401.

**TESTING MACHINE.** Wm. J. Keub, Brooklyn, N. Y., assignor to The Mechanical Rubber Co. Pat. No. 1,667,420.

**COLORIMETER.** Robert E. Klett, Teaneck, N. J., assignor to Klett Manufacturing Co. Pat. No. 1,667,478.

**MICROMETER.** Ferdinand Neubauer, Brooklyn, Ohio. Pat. No. 1,667,562.

**FLOW METER AND THE LIKE.** Louis Willard Thompson, Schenectady, N. Y., assignor by mesne assignment to Bailey Meter Company. Pat. No. 1,667,612.

## CANADIAN PATENTS

**TESTING METALLIC COATING.** Karl Pitschner, Bridgeport, Conn., assignor to American Chain Co. Pat. No. 278,333.

**REGULATORS.** Albert H. Miltag, Schenectady, N. Y., assignor to The Canadian General Electric Co. Pat. No. 278,721.

**MANOMETER.** Harold Martin, Portsmouth, County of Hauts, England. Pat. No. 278,490.

**PRESSURE GAGE INDICATOR.** Henry D. Carlton, Montclair, N. J., assignor to Mammy, Maxwell & Moore. Pat. No. 278,550.

**REGULATOR SYSTEM.** Harold W. Rogers and Edward H. Horstkotte, Schenectady, N. Y., assignor to The Canadian General Electric Co. Pat. No. 278,723.

**METER.** Thomas A. Banning, Jr., Wilmette, Ill. Pat. No. 278,819.

**WET GAS METER.** Franklin Thorp, Manchester, County of Manchester, Eng., assignor to Parkinson & Cowan. Pat. No. 278,973.

**ELECTRICAL INSTRUMENT.** Richard Henry Krueger, Newark, N. J., assignor to Chas. Engelhard, Inc. Pat. No. 279,130.

**THERMOSTAT PLATE.** Frederick Wm. Miller, of Hockley Heath, Warwickshire, England. Pat. No. 279,248.

## ENGLISH PATENTS

**INTERNAL - COMBUSTION ENGINES; THERMOSTATS.** J. Bowen, St. Thomas, Swansea, England. Pat. No. 283,436.

**CALCULATING APPARATUS.** Burroughs Adding Machine Co., Detroit, Mich. Pat. No. 283,486.

**ELECTRIC MEASUREMENTS.** H. J. Kuechenmeister, Berlin, Germany. Pat. No. 283,503.

**LIQUID-DISPENSING APPARATUS.** Gilbert & Barker Mfg. Co., West Springfield, Mass. Pat. No. 283,516.

**TAXIMETERS.** Ottico Mecanica Italinia Soc. Anon., Rome, Italy. Pat. No. 283,528.

**ELECTRIC MEASUREMENTS.** W. Kunze, Bremen, Germany. Pat. No. 283,538.

**TESTING THE WEATHERING PROPERTIES OF MATERIALS.** C. W. Jameson, Lombard, Ill. Pat. No. 283,539.

**MEASURING PUMPS.** Soc. Anon, pour tous Appareillages Mecaniques, Seine, France. Pat. No. 283,570.

**REGULATING LIQUID LEVELS, CONTROLLING FEEDWATER.** E. C. R. Marks, London, England. Pat. No. 283,604.

**ELECTRIC MEASUREMENTS.** M. E. Simon and J. A. O'Connor, Berkeley, Calif. Pat. No. 283,650.

**ELECTRIC METERS.** D. E. Rees, London, England. Pat. No. 283,656.

**TESTING PIPE JOINTS.** D. H. B. Reynolds, Hertfordshire, England. Pat. No. 283,693.

**ELECTRIC TESTS AND MEASUREMENTS.** W. E. Boyd and T. Stewart, Glasgow, Scotland. Pat. No. 283,700.

**MEASURES OF CAPACITY.** E. Templeman, Nottingham, England. Pat. No. 283,729.

**TESTING MATERIALS UNDER REPEATED STRESSES.** F. B. Dehn, Duesseldorf, Germany. Pat. No. 283,787.

**REFRACTORIES.** H. Voellmy, Basle, Switzerland. Pat. No. 283,859.

**DELIVERING MEASURED QUANTITIES.** Compagnie pour la Fabrication des Compteurs et Materiel D'Usines a Gaz, Seine, France. Pat. No. 283,884.

**WEIGHING APPARATUS.** H. J. B. Wolf, Vienna, Austria. Pat. No. 283,896.

**WEIGHING APPARATUS.** H. J. B. Wollaston, Lowestoft, England. Pat. No. 283,996.

**MEASURING PHYSICAL FORCES.** A. Berroth, Berlin, Germany. Pat. No. 284,000.

**TEMPERATURE CONTROLLING DEVICES.** N. H. Freeman, London, England. Pat. No. 284,008.

**DELIVERING LIQUIDS IN MEASURED VOLUMES.** H. W., R. V. and I. C. V. Smith, Nottingham, England. Pat. No. 284,028.

**MEASURING FEED OF GRANULAR MATERIALS; SAMPLING GRANULAR MATERIALS.** J. E. Lea, Manchester, England. Pat. No. 284,033.

**WEIGHING APPARATUS.** W. and T. Avery, Ltd., Birmingham, England. Pat. No. 284,050.

**WEIRS.** A. D. D. Butcher, Delta Barrage, Egypt. Pat. No. 284,083.

**ELECTRIC MEASUREMENTS.** Egyesulte Izzolampa es Villa-Mossagi Reszvenytar-Sasag, Ujpest, Hungary. Pat. No. 284,225.

**WEIGHING APPARATUS.** O. Meyer, Muehle, Germany. Pat. No. 284,231.

**COUNTING APPARATUS.** British Tabulating Machine Co., London, England. Pat. No. 284,241.

**DISTANT INDICATORS.** Soc. Amary et Poulet, Paris, France. Pat. No. 284,277.

**ELECTRIC MEASUREMENTS.** W. Burstyn, Berlin, Germany. Pat. No. 284,320.

**ELECTRIC MEASUREMENTS.** General Electric Co., London, England. Pat. No. 284,395.

**INDICATING LIQUID LEVEL.** King-Seeley Corp., Ann Arbor, Mich. Pat. No. 284,594.

**VIBRATION INDICATORS.** H. V. E. Vatinet and C. Durand, Seine, France. Pat. No. 284,597.

**WEIGHING APPARATUS.** Dayton Scale Co., Dayton, Ohio. Pat. No. 284,613.

**INDICATING LIQUID LEVELS.** E. Carretta, Turin, Italy. Pat. No. 284,632.

**REGULATING AND INDICATING GASEOUS DENSITY; MIXING.** Smoot Engineering Corp., New York, N. Y. Pat. No. 284,647.

**THERMOMETERS.** Thermex Soc. Anon., Geneva, Switzerland. Pat. No. 284,720.

**LIQUID-METERS.** Shell-Mex, Ltd., and C. C. Sanders, London, England. Pat. No. 284,752.

**LEVELS.** General Electric Co., Ltd., London, England. Pat. No. 284,807.

**MEASURING THE CUTTING FORCE OF A TOOL.** Z. H. R. Kenkyujo and M. M. Okoshi, Tokyo, Japan. Pat. No. 284,856.

**HYDROMETERS.** C. E. Linebarger, Chicago, Ill. Pat. No. 284,916.

**ELECTRIC MEASUREMENTS.** Atlantic Precision Co., Boston, Mass. Pat. No. 285,005.

**WEIGHING APPARATUS.** Maatschaphij Tot Vervaardiging van Snijmachines Volgens von Berkel's Patent en Van Andere Werktuigen, Rotterdam, Holland. Pat. No. 285,012.

**ELECTRIC METERS.** Allegemeine Elektricitaets Ges., Berlin, Germany. Pat. No. 285,039.

**DELIVERING MEASURED QUANTITIES OF LIQUIDS.** Soc. Hardoll, Seine, France. Pat. No. 285,060.

**How to Purchase the Right Coal for Your Plant.** W. D. Langtry. Ind. Power. March 1928, pp. 45-46, 104.

Discusses analysis of coal.

**One Way to Cut Your Power Bills.** Eugene Caldwell. Ind. Power. March 1928, pp. 49-50, 96.

Mentions importance of demand charge. Use of demand meters discussed.

**Effect of Different Systems of Lighting on Output and Accuracy in Fine Work.** Joint Report of the Illumination Committee of Department of Scientific and Industrial Research and the Industrial Fatigue Research Board, England.

In the experiments described, the effect of different installations in common use has been studied, the actual illumination being kept constant.

**Endurance of Spring Steel Plates under Repetition of Reversed Bending Stress.** Special Report No. 5, Department of Scientific and Industrial Research.

A full description of the method of test is given together with results on a large number of commercial spring steels. Results of tests are also given for some of the steels after being heat treated at the National Physical Laboratory.

**The Testing of Machinability.** (Die Pruefung der Bearbeitbarkeit.) F. Rapatz and K. Krekeler, St. u. E. March 1, 1928, pp. 257-261.

Investigations of the applicability of the different machining tests to actual practice.

**Weighing With Radio.** James Millen. Sc. Amer. Feb. 1928, pp. 138-139.

An instrument or actually a combination of instruments, is briefly described and illustrated, for the measurement and weighing of materials during the process of manufacture. The measurement is carried out by passing the material between the plates of a condenser, the change in dielectric constant of the material increases or decreases the capacity of the condenses.—M. B. R.

**Weighing the Earth.** Paul R. Heyl. Sc. Amer. March 1928, pp. 205-207.

The torsion balance is popularly described in this article.

**How Fast Can You "Get Away?"** Walter Miles. Sc. Amer. March 1928, pp. 226-229.

A means of measuring the amount of time required by an individual is here described and results are given on the speed in charging of football teams.—M. B. R.

**Condenser Shunt for Measurement of High Frequency Currents of Large Magnitude.** Alexander Nyman. Proc. Inst. Radio Engrs. Feb. 1928, pp. 208-217.

The necessity for an accurate ammeter for large high-frequency currents is pointed out. A new device consisting of a large condenser in parallel with a small condenser, and the latter carrying the current to a small thermocouple ammeter, is described. A device of this nature can be made very accurate; in fact, comparable in accuracy to any available standards.

**Brick Masonry, Its Strength and Physical Properties.** L. B. Lent. Br. Cl. Rec. March 13, 1928, pp. 414-419.

Report of tests at the Bureau of Standards. Economy Wall Strengths. Fire resistance. Other properties of brick masonry. Concrete vs brick masonry. Concrete brick vs brick masonry. Sand-lime brick vs brick masonry. Cinder block vs brick masonry. Hollow tile vs brick masonry. Portable brick tester for transverse strength of brick.

**The Recording of River Discharge.** Nathan C. Grover. Military Eng. pp. 120-124.

The methods used by the United States Geological Survey are described.

**A Precision Method for the Measurement of High Frequencies.** Charles Bayne Aiken. Proc. Inst. Radio Engrs. Feb. 1928, pp. 125-136.

A precision method for the measurement of the frequency of an oscillating circuit is discussed. The theory on which the method is based is discussed and there is developed an equation which relates the frequency of the beat note between two oscillators to the natural frequency of a circuit which is loosely coupled to one of them. This equation is considered and certain of its properties deduced. Curves are drawn for three typical cases. The cause and avoidance of certain errors are considered. The method is extended to the case of a non-oscillating circuit. A method for the measurement of small values of mutual inductance is suggested.

**Factory Operation of Automatic Electrometric pH Control of Cane Juice Defecation.** R. T. Balch and H. S. Paine. Ind. Engg. Chem. April, 1928, pp. 348-353.

Automatic control of the liming of cane juices in the manufacture of raw sugar, operating on electrometric principles, was tested in a Porto Rican central over a period of four months. The results indicate a very promising means of controlling the process. The equipment consisted of (1) a recording potentiometer fitted with a controller time switch which, through relays, caused the motor of the liming device to operate in the required direction at definite intervals; (2) tungsten and calomel electrodes fitted in a continuous-flow juice chamber; (3) a temperature compensator which automatically corrected for the change in pH due to temperature variations; and (4) a tilting weir box for the liming device.—M. E. H.

**The Flammability of Refrigerants.** G. W. Jones. Ind. Engg. Chem. April, 1928, pp. 367-370.

An apparatus for determining the explosibility of gases is described and methods are discussed. The tests were made with methyl and ethyl chlorides and bromides.—M. E. H.

**SURVEYING INSTRUMENTS.** M. Glauser and Watts & Son, Ltd., London, England. Pat. No. 285,112.

**RECORDING INSTRUMENTS.** W. C. Sutherland and J. Denton, Yorkshire, England. Pat. No. 285,114.

**DELIVERING MEASURED VOLUMES OF LIQUID.** R. G. Shulze and J. W. Morton, Westminster, England. Pat. No. 285,131.

**INDICATING LIQUID LEVELS; TANK CLOSURES.** A. L. Rosenmund, Paterson, N. J. Pat. No. 285,261.

**DELIVERING MEASURED VOLUMES OF LIQUIDS.** L. H. Pietzsch, Victoria, Australia. Pat. No. 285,278.

**WEIGHING APPARATUS.** Maalschappij Tot Vervaardiging van Snijmachines Volgens van Berkel's patent en van andere werktuigen and C. F. M. Berkel, Rotterdam, Holland. Pat. No. 285,299.

**TESTING VALVES.** J. B. Fleming, Towson Heights, Maryland. Pat. No. 285,320.

**WEIGHING MACHINES.** Maatschappij tot Vervaardiging van snijmachines volgens van Berkel's patent en can Andere Werktuigen, Rotterdam, Holland. Pat. No. 285,385.

**BOWDEN PRESSURE GAUGES.** A. Weber, 28 Weyermannstrasse, Berne, Switzerland. Pat. No. 285,392.

**INDICATING VIBRATIONS.** R. Ambronn, 8 Steinsgraben, Gottingen, Germany. Pat. No. 285,420.

**TIMING APPARATUS FOR RACES.** L. C. Frager, 13 Boulevard du Montparnasse, Paris, France. Pat. No. 285,433.

**ELECTRIC CLOCKS.** Comptoir General de Vente de la Montre Roskoff Soc. Anon. Vve. C. L. Schmid et Cie., Neuchatel, Switzerland. Pat. No. 285,493.

**TEMPERATURE REGULATING DEVICES.** Selden Co., 339 Second Ave., Pittsburgh, Pa. Pat. No. 285,499.

**PRESSURE INDICATORS.** M. L. Bramson, London Aerodrome, Hendon, London, England. Pat. No. 285,525.

**INDICATING LIQUID LEVEL.** E. H. Sweet, Sussex, and J. A. Hartcup, Kent, England. Pat. No. 285,535.

**LIQUID LEVEL INDICATORS.** L. Murphy, 156 Richmond Rd., Dublin, Ireland. Pat. No. 285,552.

**ELECTRIC TESTS.** E. Ellis, Chester, England. Pat. No. 285,611.

**MEASURES OF CAPACITY.** W. & T. Avery, Ltd., and J. W. Taylor, Soho Foundry, Birmingham, Eng. Pat. No. 285,619.

**CONSTANT LEVEL REGULATORS FOR LIQUIDS.** A. Tessandie, 28 Ave. Secretan, Paris, France. Pat. No. 285,621.

**ELECTRIC METER MAGNETS.** W. Holmes and Ferranti, Ltd., Hollinwood, Lancashire, England. Pat. No. 285,633.

**WEIGHING APPARATUS.** Automatic Scale Co., Ltd., and E. L. Blick, Temperley Works, Manchester Road, Broadheath, Altrincham, Cheshire, England. Pat. No. 285,634.

**LIQUID LEVEL AND DRAFT INDICATORS.** L. Murphy, 156 Richmond Road, Dublin, Ireland. Pat. No. 285,640.

**LIQUID LEVEL INDICATORS.** A. L. Rosenmund, Albion Place Hotel, Paterson, New Jersey. Pat. No. 285,657.

**MEASURING PUMPS.** H. Muehlhaff, Uedem, Germany. Pat. No. 285,742.

**ELECTRIC METERS.** Landis et Gyr Soc. Anon., 1 Hofstrasse, Zug, Switzerland. Pat. No. 285,806.

**ELECTRIC METERS.** Landis et Gyr Soc. Anon., 1 Hofstrasse, Zug, Switzerland. Pat. No. 285,807.

**CLOCKS.** K. Meier and W. Huessy, Aarburg, Switzerland. Pat. No. 285,839.

**COLORIMETERS.** R. A. Legendre, 27 Rue d'Alesia, Paris, France. Pat. No. 285,848.

**MAGNETIC TESTS AND MEASUREMENTS.** Federated Engineers Development Corporation, 40 12 St., Long Island City, N. Y. Pat. No. 285,860.

**THERMOMETERS.** Soc. Anon des Pistons Ideal et Segments Etanches, 14 Avenue Fontaine-Argent, Doubs, France. Pat. No. 285,882.

**CALCULATING APPARATUS.** Burroughs Adding Machine Co., Detroit, Mich. Pat. No. 285,885.

**WEIGHING APPARATUS.** Pooley & Son, Ltd., and J. Dobson, Birmingham, England. Pat. No. 285,945.

**FLUID METERS.** C. Kent, Ltd., and W. G. Ardley, 199 High Holborn, London, England. Pat. No. 285,984.

**ELECTRIC TESTS.** A. G. Bullen, 79 West Walls, Carlisle, England. Pat. No. 285,990.

**REGULATING LIQUID LEVEL.** British Arca Regulators, Ltd., and T. Lindsay, Windsor House, Victoria St., Westminster. Pat. No. 286,007.

# GERMAN PATENTS

**INRICHTUNG FUER DIE WEITWENKELPROJEKTION.** Emil Busch, A. G. Rathenow, Germany. Pat. No. 453,141.

**BILDWERFER FUER AUFLICHT.** Ferma Ed. Liesegang, Duesseldorf, Germany. Pat. No. 453,142.

**FLUESSIGKUTSTHERMOMETER.** Allgemeine Elektricitaets Gesellschaft, Berlin, Germany. Pat. No. 453,184.

**SELBSTTAETIG WIRKENDE REIBUNGSBREMSE ZUR BESTIMMUNG DER LEISTUNG VON KRAFTMASCHMEN.** W. Gensecke, Homburg, Germany. Pat. No. 453,185.

**VORRICHTUNG ZUR BERICHTIGUNG DER BEIM MESSEN DER HUBHOHE A N DRUCKPRUEFMASCHINEN BEIM DRUECKEN AUF DAS PRUEFSTUECK INFOLOGE DER FORMVERAENDERUNGDER MASCHINE SICH ERGEBENDEN FEHLER.** Losenhausenwerk Duesseldorfer Maschinenbau A. C. Duesseldorf, Grafenberg, Germany, Pat. No. 453,224.

**AUF ZUG UND DRUCK BEANSPRUCHTE PARALLELOGRAMMFUHRUNG FUR DEN LASTSCHALENTRAEGER VON WAAGEN.** Stierlen-Werke, Inc., Rastatt, Baden, Germany. Pat. No. 453,439.

**AUFZEICHENVORRICHTUNG FUER SCHWINGUNGEN.** Carl Lindstrom, Berlin, Germany. Pat. No. 452,718.

**SEHROHR.** Roberto Parodi, Genua, Italy. Pat. No. 453,440.

**GESCHWENDIGKEITSANZEIGER FUER KRAFTFAHRZEUGE.** Martin Rietz, Berlin, Germany. Pat. No. 443,857.

**VORRICHTUNG ZUM PRUEFEN DER ZAHNFLANKEN VON ZAHNRAEDERN.** Gear Grinding Co., Ltd., Birmingham, England. Pat. No. 453,629.

**THEODOLIT MIT EINRICHTUNG ZUM PHOTOGRAPHISCHEN ABBILDEN DER BEIDEN TEILKRUSSTELLUNGEN FUER DAS FESTLEGEN VON BEWEGUNGSBAHNEN.** Askania-Werke, A. G., Berlin-Friednau, Germany. Pat. No. 453,719.

**Physical Testing Machines.** (Materialpruefmachinen.) W. Deutsch. Messtechnik. March 22, 1928, pp. 62-64.

History. Tensile machines. Measurement of force. Calibration. Machines for the testing of hardness, technological tests, dynamic tests, continuous tests, torsion tests, wear tests.

**The International and the Absolute Electrical Units and Their Relation to One Another.** (Die internationalen und die absoluten elektrischen Einheiten und ihre Beziehung zueinander.) W. Jaeger. Messtechnik. March 22, 1928, pp. 65-69.

General remarks on the absolute and international electrical units. Use of the international units with the practical electrical and magnetic measurements. The absolute electrical units and measuring system. The empirical international electrical units. The numerical relation between the absolute and the international units.

**Photography in Science II.** I. W. D. Hackh. Camera Craft. January, 1928, pp. 26-29.

Popular account of astronomical photography and its value in measurement of the stellar universe. Abs. Bull. Kodak Research Lab.

**The Absolute Measurement of the Dose Unit, "One Roentgen" in the German Bureau of Standards.** H. Behnken. Radiology. Jan., 1928, p. 82.

To facilitate a control of the roentgen unit as defined by the German Bureau of Standards, Behnken gives in this paper a detailed account of his apparatus method. Abs. Bull. Kodak Research Lab.

**The Progress in Standardization in X-Ray Measurements.** Radiology. Jan., 1928, pp. 70-71.

The Bureau of Standards has planned a program on the design, construction and standardization of instruments for measuring X-rays; tests of efficiency of various kinds of X-Ray apparatus and tubes; a study of X-Ray protective devices and materials; and the development of possibilities in the use of X-rays in the industries and arts. Abs. Bull. Kodak Research Lab.

**Physical Test Specimens from Commercial Steel Castings.** Research Group. News. April, 1928, pp. 175-180.

A. S. T. M. report on test coupons. Conditions affecting physical properties. Susceptibility of all metals to manufacturing processes. How material in steel castings should be tested. Data from tests of unsuitable specimens. Dependability of metal parts despite poor tests from certain sections. Importance of design.

**A Metallographic Study of the Path of Fatigue Failure in Copper.** Herbert F. Moore and F. C. Howard. Bulletin 176, Engg. Exp. Sta. Univ. of Ill., 25 pp.

This bulletin contains a report of a study of the fatigue failure in copper by means of metallographic examination.

**An Investigation of Web Stresses in Reinforced Concrete Beams, Part II.** Frank E. Richart and Louis J. Larson. Bull. 175. Engg. Exp. Sta. Univ. of Ill. 74 pp.

This bulletin contains the report of an investigation, the purpose of which was to study the action of web reinforcement in overhanging or restrained beams in which there are both positive and negative bending moments.

**Geophysical Methods of Prospecting.** A. S. Eve and D. A. Keys. Tech. Paper 420. Bureau of Mines. 26 pp.

A general treatise on geophysical prospecting. Magnetic methods. Gravitational methods. Electrical methods. Seismic methods. This paper is also being reprinted in Scientific American beginning with May, 1928, pp. 414-417.

**Sleuthing for Boiler Room Losses.** A. Nielsen. Ind. Power. April, 1928, pp. 56-59, 118.

The use of instruments in the intelligent operation of the boiler room is taken up.

**Weigh Larries.** Ind. Power. April, 1928, pp. 158-160.

Some advantages of their use in coal handling are taken up.

**Suggestion for Testing Service Lines.** A. C. Bebens. Gas Service Journal. March, 1928, pp. 3-4.

Method of testing service lines briefly described.

**Measuring the Fuel Consumption of Japanning Ovens.** W. J. Miskella. Fuels & Fces. April, 1928, pp. 507-509.

Discussion of the construction and operating features of gas meters as applied to japanning ovens.

**Orientation of Aerial Photographs bv Means of Gnomonic Projection.** (Ueber die gegenseitige Orientierung von Fluganfnahmen mettels gnomonischer Projektion.) Christian Schmidt. Zs. Vermess. April 1, 1927, pp. 209-219.

Introduction. The calculation of the space coordination based on gnomonic projection. Continued in next issue.

**The Gunnery Gyro-Compass.** Sperryscope, pp. 9-10.

The instrument is briefly described.

**VERSCHLUSS VON FLUESSIGKEITS-DAEMPFUNGSGEFAESSEN FUER MESSINSTRUMENTE.** Johann Koenigsberger, Freiburg, Germany. Pat. No. 453,720.

**VERFAHREN ZUM MESSEN DER DURCHFLUSSMENGE IN EINER VON EIMER HAUPTLEITUNG ABGEZWEIGTEN NEBENLEITUNG.** Walter Tropitzsch, Dresden, Germany. Pat. No. 453,675.

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**UMLAUFZAEHLER, INSBESONDERE ZUM FESTSTELLEN DES GARNDRAHTS DURCH ZAEHLEN DES SPINDELUMLAUFS.** Emil Engelmann und Georg Engelmann, Goerletz, Germany. Pat. No. 453,859.

**A New Registering Photodensitometer.** Elmer A. Harrington. Jl. Opt. Soc. March, 1928, pp. 211-223.

A direct-reading, self-recording densitometer with single thermocouple and low-resistance D'Arsonval galvanometer has been constructed and used to measure the relative capacities of the photographic images of the lines in ordinary spectra and in X-ray powder photographs. By suitable gearing to an electric motor the photographic negative is given a slow motion at right angles to a beam of light passing through a horizontal system; and at the same time a drum carrying photographic paper, on which a spot of light from the galvanometer is focussed, is caused by the same motor to rotate at such a rate that a certain distance on the drum corresponds to a certain distance on the negative. A permanent record of the true distribution of opacities is thus obtained, since the deflections of the galvanometer are inversely proportional to the opacities on the negative.

Preliminary experiments show that the apparatus is dead beat and quick in response; and that it is sensitive, stable, and accurate.

**Dilatometric Analysis of Steel and Some Results of Dilatometric Heat Treatment.** R. W. Woodward and S. P. Rockwell. Trans. A. S. S. T. May, 1928, pp. 795-812.

The authors of this paper have shown that by the use of the dilatometer certain fundamental constants may be obtained. From these it is proposed to classify steels according to their proper quenching medium. Taking advantage of thermal hysteresis to lower the quenching temperatures is discussed. When this lower quenching temperature is used it is often possible to brine-quench normal oil-quenching steels to give superior results. When using the dilatometer, quenching at the completion of the transformation or point of re-expansion is obtained by the automatic signal, other fixed points on the dilatometric curve may be used to give greater depth of hardness at a sacrifice of toughness and grain size.

**On the Significance of the Proportional Limit of Steel at Elevated Temperatures.** Francis B. Foley. Trans. A. S. S. T. May, 1928, pp. 813-828.

A considerable amount of research is being carried on to determine the physical properties of steel at elevated temperatures. The testing of metal at elevated temperatures presents problems not encountered at atmospheric temperatures.

The most valuable and most difficult value to determine is the true elastic limit. The author suggests the possibility of developing a mathematical expression of the relationship of the proportional limit determined at elevated temperatures to that obtained at room temperature and gives evidence from available data of a straight line relationship between the temperature of testing and the sum of two factors; namely, the strain produced at the proportional limit and the thermal expansion at the temperature of testing.

**Light Filters for the Isolation of Narrow Spectral Regions.** Lloyd A. Jones. Jl. Opt. Soc. April, 1928, pp. 259-271.

Absorption characteristics of materials, absorption characteristics of the filters. The filters are described.

**A Suggested Arrangement for the Determination of the Velocity of Light.** Noel Deisch. Jl. Opt. Soc. April, 1928, pp. 272-275.

In place of the rotating multi-sectored disk or multi-faced mirror usually used, this method employs an electric-optic modulator. The apparatus is described and illustrated.

**An Improved Quartz Fibre Manometer.** Arnold O. Beckman. Jl. Opt. Soc. April, 1928, pp. 276-278.

Improvements on the Haber and Kerschbaum quartz fibre manometer are described. The improved manometer has the following desirable features: 1. The effect of external vibration is greatly reduced; 2, The zero point does not change; 3, the fibre is quickly and positively set into vibration; 4. the fibre can be instantly brought to rest; 5. the initial amplitude of vibration is always the same.

**A New Type of Selenium Cell.** R. Earl Martin. Jl. Opt. Soc. April, 1928, pp. 279-281.

The article takes up the shaping of the selenium, the annealing of the selenium and the attaching of the electrodes.

**An Improved Coordinator. R. A. Castleman, Jr.** Jl. Opt. Soc. May, 1928, pp. 287-292.

A coordinator assembled from a T-square, a drawing board, two slide rules and certain machined accessories has been developed as an improvement on the simple but useful device previously described. The merits claimed for the present are (a) compactness, simplicity in operation, accuracy and (b) ease of assembly from apparatus readily and cheaply available.

This paper includes a description of the device and some remarks on its design and use.

**The History of the Compass.** (Zur Geschichte des Kompasses.) P. Martell. Zs. Feinmech. March 31, 1928, pp. 5-7.

A brief history of the compass is given.

**The "Old Panorama" Photokymograph.** Walter Miles. Jl. Opt. Soc. May, 1928, pp. 283-286.

A panoramic camera which was found suitable for use as a photokymograph is desired. The camera modified to use motion picture film is described.

**A New Spectroscopic Demonstrator for the Exhibition of Emission, Continuous and Absorption Spectra.** H. T. Stetson and H. W. Geromanss. Jl. Opt. Soc. May, 1928, pp. 293-294.

The apparatus is briefly described and illustrated.

**Mapping in a New Way.** Bull. Phot. Jan. 11, 1928, p. 38.

Aerial photographs are projected on the surface of a large drum which, it is stated, will produce a stereoscopic effect. Starting from any point of known elevation, contour lines may be drawn. The system requires three measurements to every 65 miles. Abs. Bull. Kodak Research Labs.

**The Thring High Pressure Indicator.** Eng. March 16, 1928, pp. 298-299.

This optical instrument gives a complete record of the pressures that occur in the barrel of a gun or rifle during the explosion of the charge from the commencement of ignition until after the bullet has left the muzzle. The construction and operation of this indicator are described together with a cross-sectional view, photographs, and several pressure-time diagrams recorded by this instrument.—P. G. McV.

**Convenient Forms of Magnetometers.** S. R. Williams and W. J. Eckert. Jl. Opt. Soc. Mar., 1928, pp. 203-207.

Two magnetometers are described in this article.

**A Simple Spectrocomparator.** F. Stanley. Jl. Opt. Soc. Mar., 1928, pp. 208-210.

The spectrocomparator manufactured by Bellingham and Stanley, Lt., London, is described.

**A Fluorescent Ultraviolet Violet Photometer.** W. T. Anderson and E. Gordon. Jl. Opt. Soc. March, 1928, pp. 224-230.

A special arrangement for fluorescent photometer is described and illustrated.

**The Accuracy of Commercial Screw-Threads.** Special Report No. 4, Engineering Research, Department of Scientific and Industrial Research.

The report contains the results of measurements made at the National Physical Laboratory on a large number of screws and nuts taken from the current stocks of firms representative of the various branches of mechanical and electrical engineering. It shows to what extent the existing tolerances are actually worked to in practice and how far screw threads made to these tolerances, or otherwise actually obtainable commercially, are regarded as satisfactory by different classes of users.

**The Cylinder as a Test Specimen.** Concrete Highways and Public Improvements. April, 1928, p. 74.

The use of the cylinder as a test specimen is discussed.

**Easy Method for Testing Welds for Ductility.** Oxy-Acetylene Tips. April, 1928, pp. 162-164.

The vise bend test of welded specimens is described.

**Directory of Commercial Testing and College Research Laboratories.** Miscellaneous Publication No. 90. Bureau of Standards.

Information is given concerning 271 commercial testing laboratories, with 92 branch laboratories or offices. A list of 186 college laboratories are also given.

**The Corrosion of Iron Return Mains.** O. A. Hill, Jr. Gas Age-Record. March 31, 1928, pp. 429-430.

Procedure and results obtained in tests made on effects of $CO_2$ gas and imposed electromotive forces in steam heating plants.—M. B. R.

**Bottle Test for Sand Control.** Ir. & St. Canada. March, 1928, pp. 86-87.

Grain size principal thing to watch. Bottle and vibrator test recommended. Watch facing sand.

**Methods of Testing Ball Bearings.** (Pruefverfahren fuer Kugellager.) T. Damm Werkst. Techn. March 1, 1928, pp. 115-118.

Object and demands placed on ball bearings. Type of failures and their magnitude. Methods of testing.

**Measuring Instruments for Roller Bearings and Their Races.** (Messgeraete fuer Rollenlager und ihre Gegenstuecke.) M. Bartholdy. Kerkst. Techn. Mar. 1, 1928, pp. 118-123.

Limit gauges, micrometers and dial gauges are discussed applied to grinding machines. Automatic grinding machines and automatic sorting machines. Dial gauges for finishing roller bearings and the bearing ring are described.

**The Accuracy of the Manufacture of Screw-Thread Micrometers and Their Fulfillment in the Measuring Science.** (Die Herstellungsgenaughkeit der Gewindelehren und ihre Messtechnische Erfuelling.) G. Berndt Werkst. Techn. March 1, 1928, pp. 131-136.

After describing various arrangements of screw-thread gauges for metric and Whitworth screw threads, the manufacturing accuracy required by D. I. N. 2244 is explained, how it can be obtained with the measuring microscope which is briefly described. The cutting corrections are especially mentioned. Several results obtained with this as well as with mechanical measuring methods is given and the corrections which must be kept in mind with the three wire method are pointed out.

**Expansion Characteristics of Low-Expansion Nickel Steels.** Howard Scott. Trans. A. S. S. T. May, 1928, pp. 829-847.

An expansion test apparatus with which continuous thermal expansion curves can be obtained with good accuracy from liquid air temperature to 1110 degrees Fahr. (1600 degrees Cent.) is described.

Expansion curves were taken on a series of low-expansion nickel steels and synthetic iron-nickel alloys. The results were reduced to convenient tabular form and plotted to show the variation of the chief expansion characteristics with nickel content.

The detrimental effect of manganese and silicon on the expansion properties was shown and the values of these properties estimated for zero percent manganese and silicon. The advantage of cold working to reduce the coefficient of expansion was confirmed.

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6. Electrical Energy.
7. Power, Work and Output.
8. Temperature and Moisture.
9. Heat Units and Combustion.
10. Pressure Differences.
11. Speed, Acceleration, Time.
12. Specific Gravity and Density.
13. Physical Properties.
14. Vibration, Sound, Light, Color.
15. Chemical Analysis.
16. .....

*See Other Side*

Fill in the names of men holding the following positions in *your company*. You will be doing them a service as they will be interested in receiving this periodical regularly.

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Superintendent .....

Consulting Engineer .....

Chief Engineer.....

Mechanical Engineer.....

Electrical Engineer.....

Plant Engineer.....

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Production Engineer.....

Efficiency Engineer.....

Chief Inspector.....

Chief Electrician.....

Instrument Man.....

Pyrometer Man.....

Chemist .....

Metallurgist .....

Physicist .....

Research Engineer.....

Test Engineer.....

Plant Librarian.....

Other Men.....

.....

.....

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Below are standard file cards, which the editor believes will be a valuable asset to you personally. These cards will be bound in each issue of Instruments and will cover the original articles contained in that issue. The color of the card and ink to be used is shown here. This will facilitate distinguishing the INSTRUMENTS FILE CARDS from others with which they might be consolidated.

The editor suggests that these cards be carefully cut out immediately on receipt of INSTRUMENTS and filed in your desk or in a file box on top of your desk. You will then have within easy reach an index of instrument information of incalculable value.

The card is arranged with a space for classification subject or number at the top. Suggestions as to classifications for the cards below are:

INSTRUMENT PIONEERS
AIR-CRAFT INSTRUMENTS

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INSTRUMENT PIONEERS—WILLIAM THOMSON (Lord Kelvin) (1824-1907)

INSTRUMENTS, Vol. 1 No. 5, May, 1928, pp. 219-222, 1 fig.

An abridged history of Thomson's life.

---

HOW LINDBERGH GOT ACROSS

**BRADLEY JONES**, INSTRUMENTS, Vol. 1 No. 5, May, 1928, pp. 223-227, 4 figs.

Lindbergh's instrument board is described and illustrated. The function of the various instruments is briefly discussed. The earth induction compass developed under the direction of the Army Air Corps is taken up in some detail.

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THE NEW SEISMIC STATION AT FORDHAM

**PROF. JOHN W. TYNAN, S. J.,** INSTRUMENTS, Vol. 1 No. 5, May, 1928, pp. 229-231, 2 figs.

The construction of the new building is taken up. The special features of the construction are given with the reasons for adopting this type of construction.

ELECTRICAL STANDARDS

**PROF. W. R. WORK,** INSTRUMENTS, Vol. 1 No. 5, May, 1928, pp. 233-236.

The reason for the calibration of ammeters, voltmeters and wattmeters is mentioned. The method of arriving at and checking standards of the ohm, the ampere and the volt is given. The use of the potentiometer and standard cell for precision voltage measurements is discussed.

This is a preprint of a lecture to be given before the Meter Course, given at the Carnegie Institute of Technology.

DEMAND TOTALIZING BY THE IMPULSE METHOD

**CARL OMAN,** INSTRUMENTS, Vol. 1 No. 5, May, 1928, pp. 237-242, 8 figs.

The equipment and circuits for demand totalizing by the impulse method are taken up in detail.

This is a preprint of a lecture to be given before the Meter Course, given at the Carnegie Institute of Technology.

*Illustrated above is the new Tycos Direct-Set Recording Regulator.*

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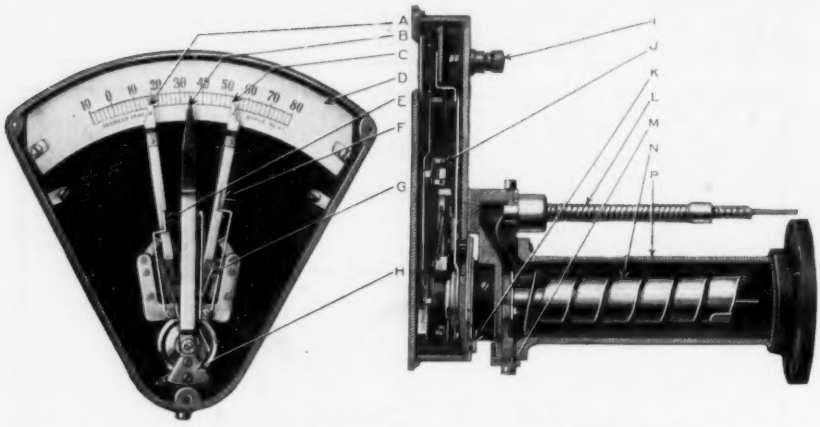


## CONSTRUCTION DETAILS OF BRISTOL'S THERMOSTATIC CONTROLLER

A—LOW ADJUSTABLE CONTACT ARM.
B—INDICATING POINTER.
C—HIGH ADJUSTABLE CONTACT ARM.
D—SCALE PLATE.
E—LOW ADJUSTABLE CONTACT.
F—HIGH ADJUSTABLE CONTACT.
G—CONTACT SPRING.
H—POINTER COUNTERWEIGHT.
I—BINDING POSTS.
J—INDICATING POINTER CONTACT.
K—BUTTON FOR ADJUSTING CONTACT ARMS FROM OUTSIDE OF CASE.
L—ARMORED CAPILLARY TUBING EXTENDING TO BULB.
M—ZERO ADJUSTOR.
N—SENSITIVE PRESSURE SPRING.
P—PRESSURE SPRING HOUSING, ALSO FORMING BRACKET TO FASTEN INSTRUMENT TO WALL.

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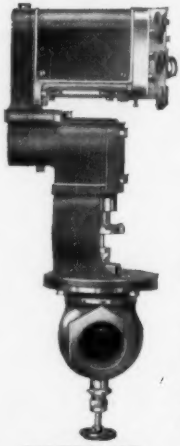

CONTROLLER VALVE—
used for air, gas or premixed gas and air.

### Contact Arms Easily Set Anywhere on Scale

In the above illustration, the adjustable contact arms are shown several degrees apart. However, each arm can be set independently to any point on the scale. When set close together the indicating pointer moves about 1/32 of an inch to leave one contact and touch the other. Under such flexibility of setting, the closeness of control which can be secured is readily apparent.

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